Editorial

THE outlook for Australian research has never been brighter than it is today.

Recent tremendous advances in nuclear and electronic engineering have shown that no country can afford to be without its own sources of information, experiment and training. And this will become even more true as the years step up the tempo and scope of scientific progress.

Australia has always produced men of high ability in various fields of learning. But as soon as they began to test their wings, they went overseas, mainly because they could learn nothing more here. Nor could they find enough scope for their work to induce them to return.

Today we see a determined and successful effort to provide every incentive for brilliant Australians to stay here and work, and even to attract new brains from overseas on a temporary or permanent basis.

The field of nuclear research has without doubt been most familiar to the public, not only because of its associations with the atom-bomb, uranium fields, Geiger counters and so on, but because there has been a great deal of rivalry between the major Australian teams with ambitions to become pre-eminent in this field. The public may have been amused if somewhat confused about the picture in particular, but there is an element of danger in it, even if we admit that competition is a good thing.

The cost of nuclear machines, to use a general term, is very great. If Australia is to play a leading part in research, and not merely to repeat or duplicate work done elsewhere, it seems desirable that effort is not dissipated by doing too little in too many places.

Australia cannot yet afford too many technical prima donnas working to build small empires, when one or at the most two would allow better facilities, without prejudice to the training programs which must go along with the work of any university.

A notable example of effective co-ordination is given by the work of Dr. E. G. Bowen and his Radiophysics group, recently the recipients of a valuable overseas offer of money to build a new radio telescope.

The outstanding and original results obtained by this group would have been impossible without intensive and concentrated work by a co-ordinating authority, the CSIRO, and conservation of material effort.

I feel there may be a lesson here to be learnt by others.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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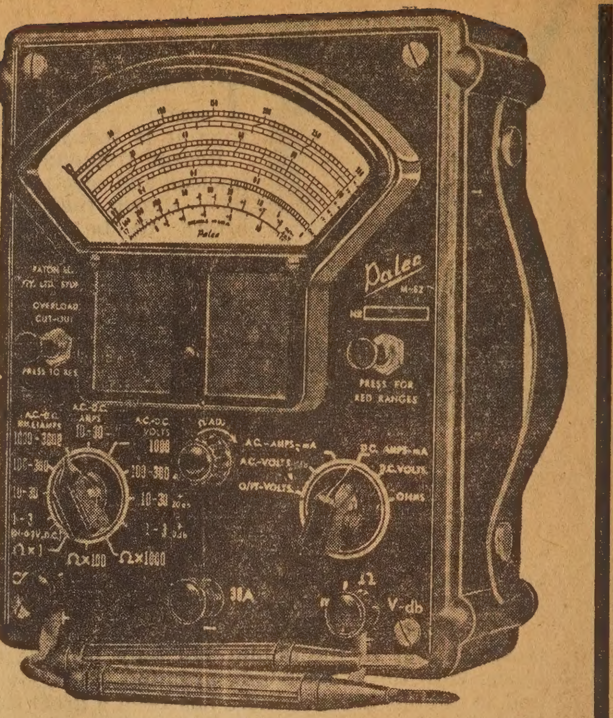

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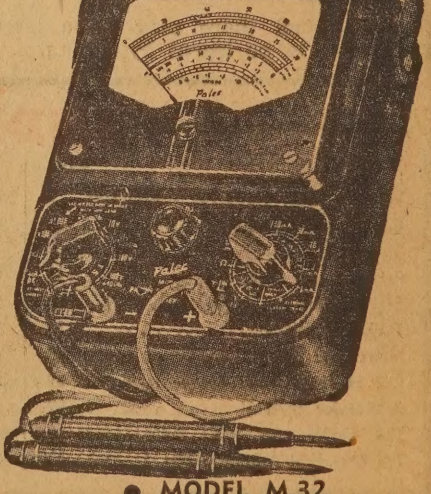

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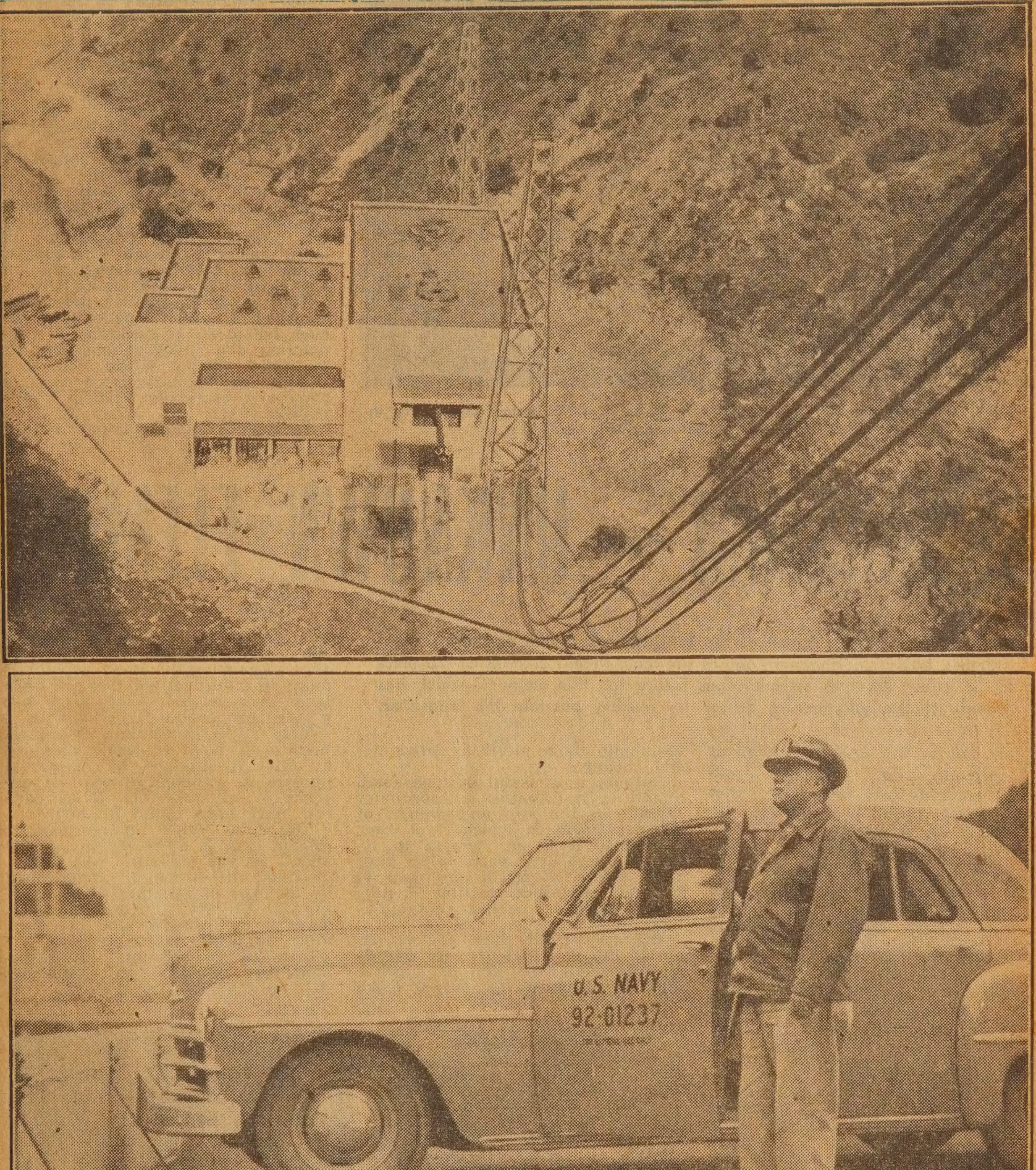
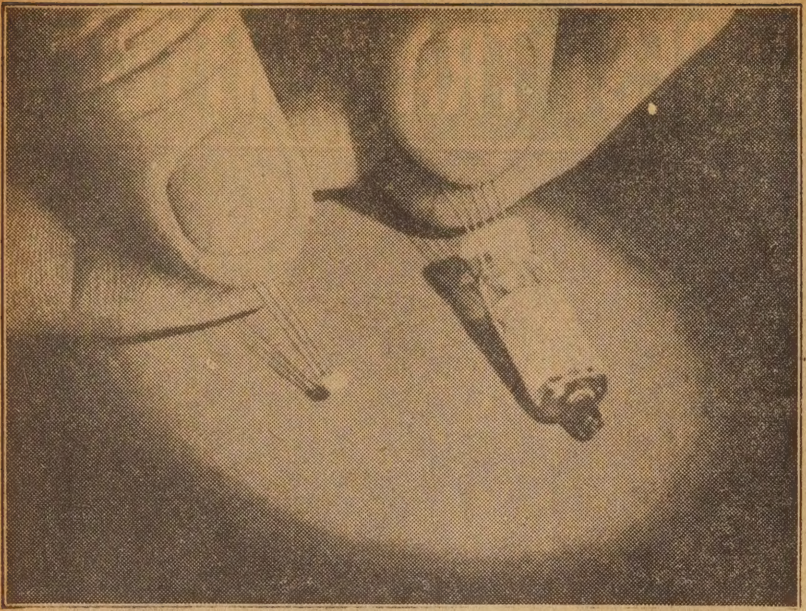


Two further pictures of the world's most powerful transmitter operated by the US Navy at over one-million watts and audible all over the world. The building is copper-lined and roofed. Each tower leads in half the antenna into the helix room housing huge loading coils. The earth net has 200 miles of wire. Vehicles in the vicinity must be grounded at the bumper bar on special contacters to avoid RF burns when alighting. Very low frequencies are used.



The smallest type of electron tube shown at the right of this picture seems large in comparison with the tiny diffused junction transistor.

GERMANIUM — UNKNOWN ELEMENT

There is more than a touch of the fantastic about the extraction from chimney pots of germanium, one of the most recent marvels of the electronic age. There is an enormous future for this element, which has already shaken engineering design by making possible the transistor.

WE call it the unknown element because the engineers and scientists who work with it say that the surface of its potentialities has hardly been scratched.

While it has already been put to many uses and has obvious possibilities for others, those who know it say that it may very likely have a future significance comparable with electronic tubes which have brought us television, radio, radar, self-opening doors, and innumerable other devices and systems which were not even thought of until the tube came along to do the job.

WHAT IS GERMANIUM ?

First of all it's an element, number 32 in the list of 96 chemical elements. It's metallic, a little lighter than zinc or iron, but much more expensive. In a pure state it has the grey sheen of silver.

It costs about the same by weight as gold, but because such a little bit will do a big job it is, in fact, fairly inexpensive to use.

In many cases where germanium is needed, a tiny piece worth only a fraction of a penny and no larger than a matchhead is suitable.

In electronics, as the name implies, the handling of electrons, tiny particles of charge which fluctuate around the atom, is the most important factor. Germanium has certain properties which enables it to handle these electrons efficiently and cheaply.

Because it is useful in such small quantities it promises extraordinary savings in the size and weight of the equipment in which it is used.

Because it is an element in itself, with no little parts to go haywire inside of it, it promises to be practically indestructible if properly sealed up against contamination.

Because of all these factors—its cheapness, its efficiency, its usefulness in small sizes and its dependability—it promises not only to make possible major improvements in existing electronic equipment, but to lead to the development of new equipment as yet undreamed of.

Clemens Winkler, of Germany, discovered it in 1886 and named it after his native land.

By deduction and investigation into the properties of matter, Mendeleyev prior to Winkler had found that known elements could be fit into an arrangement known as a periodic table and decided that there was a place in the table for an element such as germanium.

It remained for Herr Winkler to locate the element and find that the Mendeleyev had hit germanium right on the head.

For many years, germanium had little or no value, while scientists and engineers were bedazzled by the properties and possibilities of more glamorous metals, like copper, which could carry a great load of electricity with fabulous rapidity.

The search for smaller, more efficient electronic components, however, led to the re-discovery of germanium and investigations into its properties during World War II.

Most germanium is found in chimneys, especially English chimneys.

It is deposited on smelter chimney flues in this country as a waste in the refining lead, titanium, and zinc. An unusually large amount is found in industrial chimneys in England, because coal used there has a large proportion of germanium.

Very little germanium is mined, because it is more easily obtained as the by-product of industrial operations, although substantial deposits of ore quite rich in germanium have been found in Africa.

The total value of germanium sold in USA is estimated to be only about 500,000 dollars. As a by-product, its price is determined by the cost of isolating and purifying it to the necessary extent. Twenty carloads of zinc ore rock must be processed to recover one pound of germanium. However, it is used in such small quantities that the material cost is small.

This germanium ingot is chemically and electrically pure.

Diamond saw cuts wafers, which are etched and copper plated.

About half a dozen major manufacturers buy most of the country's germanium output, and the General Electric Company buys more than 50 pc.

In addition to its electronic applications, germanium is also used in a type of fluorescent light known as a Krypton lamp, which gives brighter light with the aid of a coating of germanium phosphor.

From the chimney, the dust is gathered, refined to a germanium dioxide, and delivered as a fine white powder which is spectroscopically pure, but still as much as a million times too dirty for use by the various manufacturers of germanium products.

This white powder undergoes such refining and purification that impurities become immeasurable even by the most advanced methods.

The germanium dioxide is reduced to almost pure germanium ingots, weighing about two ounces. The ingots are melted in an elongated boat which is then passed gradually under heat.

WHAT THEN ?

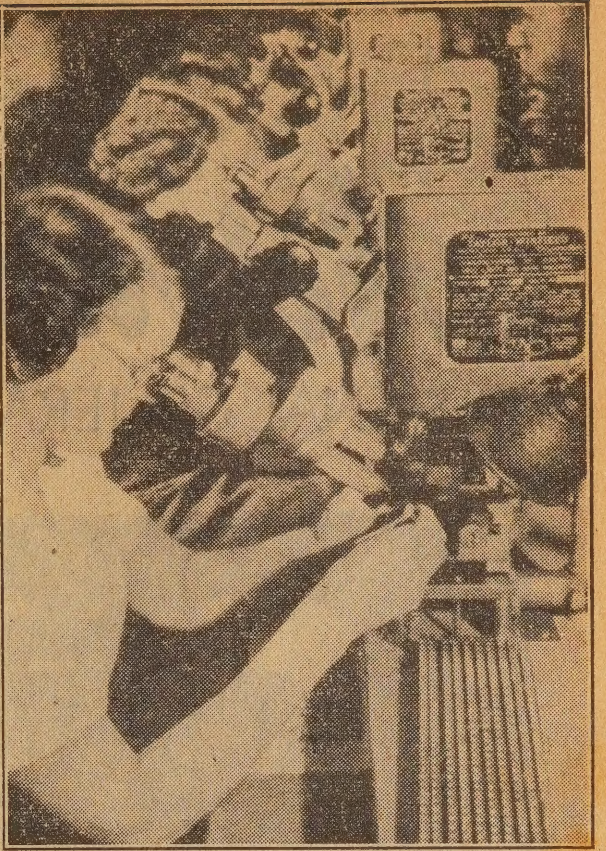
As one end of the tray of molten germanium passes out of the heat, the germanium solidifies and the impurities are pushed along into the still molten area. Eventually most of the impurities are chased down to one end of the tray, the whole bar is solidified, and the impure end is chopped off and set aside for future reprocessing.

The pure portion goes through the same process three or four times. At the end of the processing, impurities measure, as close as can be determined, slightly more than a trillionth (that's 1/1,000,000,000,000) by weight of the pure portion.

The impurities are so small that they cannot be measured or detected directly. Their presence can only be detected by passing an electric current through the germanium under special conditions, and measuring the reaction.

By this time, about 10 pc of the original germanium has been converted to waste. Actually, little is wasted because the waste is either reprocessed or returned to the supplier for reprocessing.

In the final processing, another 50 pc is "wasted". The pure block of germanium is diced with diamond saws (actually bronze wheels impregnated with diamond dust) into squares a fiftieth of an inch thick and measuring 35 thousandths of an inch on a side. Because a diamond saw eats away a line of germanium as thick as the final slices, another great quantity of germanium dust goes into the waste for reprocessing.



So small are the transistors for which germanium is used that girls must use a mircroscope to assist when welding catwhisker to pin assembly of a germanium diode

These tiny finished pieces represent only about 8 pc of the germanium that originally went into the trays for purification.

For some applications, these tiny wafers are immediately usable. For other applications, it is necessary to work with single crystals of pure germanium which are obtained by inserting part of a crystal, known as a "seed", into a crucible of molten germanium and slowly withdrawing it. When the seed is withdrawn, a single usable crystal is formed.

Now germanium is ready to go to work.

Where?

Basically in three different types of electronic parts.

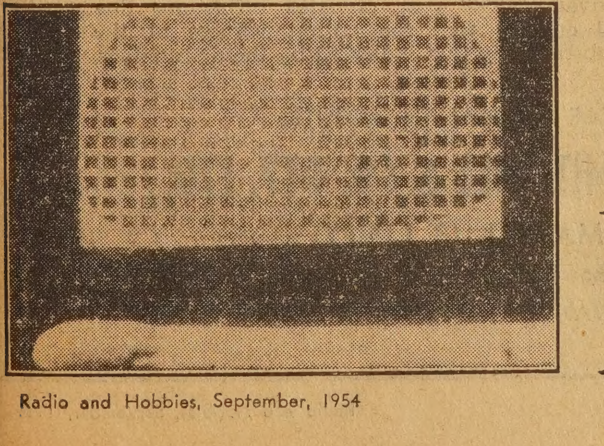
They are the germanium or "whisker" diode, a throwback to the old "cat's-whisker" crystal radio sets and the oldest of the current germanium products; the germanium rectifier, newest commercial application of germanium; and the transistor, an unimpressive looking little gadget, not yet being sold on a large scale, which holds many of the germanium potentialities in its tiny bulk.

As far as the germanium is concerned, the basic difference in these products is based on impurities. That's right, impurities, in spite of the efforts to obtain germanium as pure as a lonely virgin on a desert isle.

By inserting various impurities into the germanium in certain ways, the engineers can control the flow of electrons through the germanium.

At present, the use of germanium is limited, in comparison with what is expected in the future.

Nevertheless, there is a germanium diode in every recent-model television set which has replaced a tube and does a more efficient job of detecting radio signals. Diodes are also being applied in radio receivers, electronic computers, walkie-talkies, and a host of other civilian and military equipment.



A diamond saw cuts the wafers into tiny pellets for transistors. Note matchhead for size comparison.

The transistor is a bit of wire and plastic, about half the size of a paper clip. It can be made as small as a matchhead or smaller. There seems to be no definite size limit. Mounted in this bit of wire and plastic is a tiny speck of almost pure germanium, which harnesses electrons to do work they normally do in the vacuum of an electron tube.

THE TRANSISTOR

The transistor saves space; it is impervious to shocks, blows or vibrations; it is eventually expected to be cheaper than the corresponding vacuum tube. Several thousand transistors can be operated on the same amount of power it takes to operate a single vacuum tube such as is used in a radio or television set.

The transistor has its drawbacks. Its use at high frequencies is limited at present, although engineers are constantly advancing the upper limits. Its resistance to heat is none too good. It has not yet been adapted to assembly-line production. Nevertheless, the electronics industry regards it as the glamor baby of the germanium field.

Here's an example of what the future holds. A major portion of the cost of hearing aids results from the frequent replacement of batteries, which runs as high as several dollars each month.

Should tiny germanium transistors replace tubes in hearing aids, the batteries which are used to heat the tube filament would be eliminated.

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Transistors engineers predict, incidentally, that the hearing aids will be one of the first major commercial applications of transistors.

Other developments, no less spectacular, are foreseen by the engineers who have been close to the transistor situation. For example, the fictional wrist-watch two-way radio which Dick Tracy has been using for years in his comic strip sleuthing may actually become a reality. Using transistors, engineers have already developed a tiny experimental transmitter small enough to fit in your vest pocket. And a really personalised radio comparable in size to a wrist watch running indefinitely on one set of batteries is within sight.

INDUSTRIAL USES

On the industrial front, the giant computers which use thousands of electronic tubes in the solution of complex mathematical problems may be miniaturised from the size of a room to the size of a desk with the use of transistors and diodes.

And obviously the range of standard industrial electronic equipment which could be miniaturised and made more efficient with germanium products is tremendous.

The new germanium rectifier already placed on the market is presently the most efficient rectifier ever produced in terms of power losses. It is designed for use in television sets and a wide range of other electronic equipment.

In the military field, there is, of course, keen interest in the development of transistors. Nowhere else are size and reliability so vital as in military electronics equipment — in the radar, communications, and control systems in military aircraft, as the walkie-talkie set strapped to the radioman's back, and the radio sets which take a beating in giant tanks. Besides saving space, transistors, having no internal parts to shatter or jar loose, can stand up to the rigorous demands of combat duty without danger of failing.

WHAT ABOUT VALVES ?

How about germanium's effect on electronic tubes—at present a 430,000,000-dollars-a-year industry?

Engineers see transistors actually boosting tube growth.

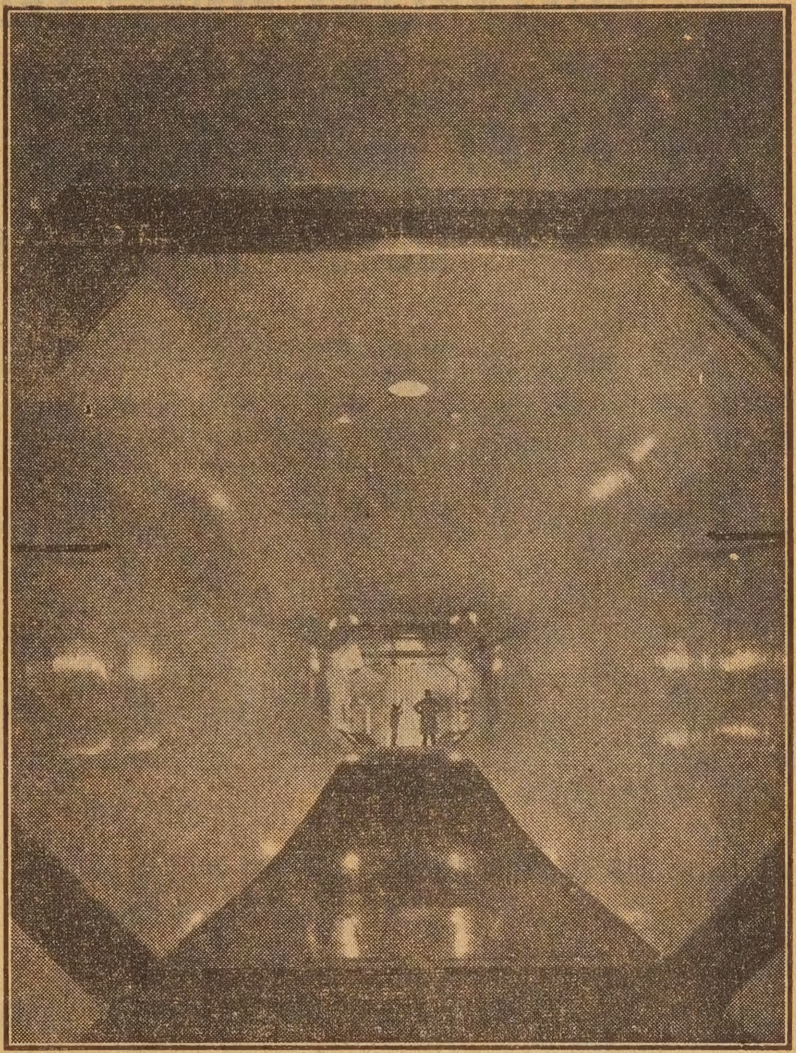
The vast range of new applications for electronics expected to develop from the widespread use of germanium can be expected to lead to new products in which tubes will be used.

Use of tubes at high frequencies is expected to be extensive. And, of course, you can't put a television picture on a pin-headed transistor. More than one-third of the tube business is in the cathode ray picture tube field, where no substitute has yet been suggested.

Recently G-E had this to say about germanium:

"Now, when we may be standing on the brink of what may well be the next phase of electronics' growth—the 'era of germanium'—it is difficult to predict all the effects it may have, to foresee the magnitude of growth it portends, or to conjure up all of the new products and techniques that may emerge and their effects on marketing and industry. Over-statements now may well prove to be pale shadows of the realities to come."

WIND TUNNEL AIDS RESEARCH



This low-speed wind tunnel built at the de Havilland aircraft works at Hatfield, Hertfordshire, is one of two recent installations which will assist in the design of new aircraft. The tunnel is of the return circuit type with a closed rectangular working section 9ft wide and 7ft high. A 12ft four-blade fan, driven by a 500 hp electric motor, provides the motive power, producing wind speeds of up to 170 miles per hour in the working section. The speed of the fan can be varied.

An electronic control keeps the apparatus constant at the selected speed. The forces and moments experienced by a model are transmitted to a six-component mechanical balance. On this—the first of its type—it is possible to read simultaneously all six components of load—lift, drag and side force, as well as moments of pitch and roll. Increase in aircraft high-speed performance emphasises the need for good low-speed behavior, and this new low-speed tunnel working alongside its partner, the high-speed tunnel, will play an important part in extensive pre-flight aerodynamic testing of new designs and research on general aerodynamic problems.

Turbo-prop Viscounts for Australian air

Every year in Australia there is a great increase in passenger traffic which starts about Christmas time, and Trans-Australia Airlines hope to have a new fleet in service in time to meet the rush. Six Viscounts, the first of which was christened recently, will be replacing piston-engined Convair 240 airliners.

The Viscounts will be the first turbo-prop airliners to go into service anywhere in the world outside Europe, and their performance in Australia will, therefore, be watched with great interest, particularly as another Australian company, Butler Air Transport, has also ordered two.

The last of the six airliners to be delivered to TAA will be the first Viscount equipped with auxiliary long-range fuel tanks. These will increase the tank capacity from 1720 to 1950 gallons. The same aircraft will also be fitted with a new mark of Dart engine, the 506, which will give the aircraft 18 mph more cruising speed, combined with lower fuel consumption, and a consequent reduction in operating costs.

34 Viscounts have now been delivered out of a total of 101 ordered. It is expected that contracts will be signed before long for the construction of a further 20 aircraft at least.

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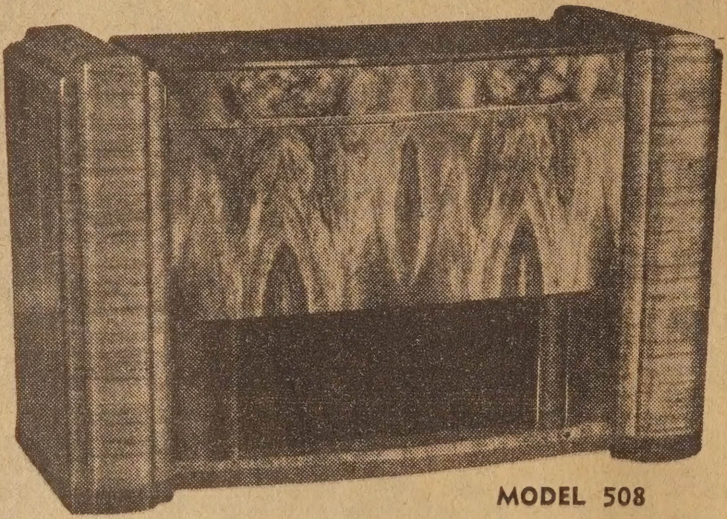

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ELECTRONIC EYES FOR THE BLIND

OBSTACLE DETECTOR IN ACTION — A blind subject is shown here testing the obstacle detector now being improved by Prof. Thomas A. Benham of Haverford College. Through a modulated light and optical-system, the device has guided the man safely between the light pole and the fire hydrant.

Scientists are developing electronic "eyes" for the blind. Designed for those who prefer an instrument to seeing-eye dogs, canes and friends, the devices warn their users of hazards which the blind person encounters on busy sidewalks and around the house.

ONE such instrument is being created by Dr. Clifford M. Witcher of the Massachusetts Institute of Technology's research laboratory of electronics.

Dr. Witcher calls his device a "step-down detector". When the user approaches a curb, a flight of steps or the edge of a subway platform, the detector buzzes a warning.

The step-down detector is only half of the instrument a blind person needs, Dr. Witcher believes. The other half should be some sort of an obstacle-finder — something that could warn the user that he is about to walk into a pole.

EXCITED OVER PROGRESS

Prof. Thomas A. Benham, of Haverford College, Haverford, Pa., is working on the obstacle detector. Under sponsorship of the Veterans' Administration, Prof. Benham has taken a US Signal Corps sensory aid, tested it, discovered its weaknesses, modified it and now is supervising its development at Biophysical Instruments, Inc., in Philadelphia.

A laboratory bench model has been re-designed to omit some of the weaknesses of the original Signal Corps model. Using transistors for vacuum tubes, the obstacle detector has no moving parts, less battery drain, a lighter battery supply and an overall weight about 40 pc less than the original model.

Dr. Witcher and Prof. Benham are keeping close contact with each other. Each is excited over the progress the other is making in improving his device. The two experts hope both aids can be combined into a single unit in about a year.

Even if this goal is attained, however, it will be two or three years before a completely satisfactory laboratory model will be obtained. The device might then go into commercial production if some means of financing the venture can be worked out.

MANY PROBLEMS

The two scientists have plenty of problems to untangle before their devices will meet the general specifications for such aids. As stated by Dr. Witcher and Prof. Benham, travel aids should: Weigh no more than four pounds; cost no more than £100; present warning signals that will not interfere with normal use of the ears; work as well on miserable days as in bright sunny weather; indicate step-downs at least five feet ahead of the user; warn of obstacles about 10 feet away, indicating the position of each and presenting the indication at such a speed that the user can walk at four to five feet a second.

Furthermore, it should not be conspicuous or require great physical or mental effort. It should provide more useful data about the user's immediate surroundings than he can get by listening or tapping with a cane. It also should not require the user to have exceptional abilities or to undergo an unduly rigorous training period.

Dr. Witcher's step-down detector is housed in a slender box-like case and is carried by a big handle on one end. A flashlight bulb and reflector vibrate in a quiet purr to modulate the light picked up by the optical system in the top of the case.

When a kerb is approached, no modulated light is reflected into the lens for a moment. This triggers the buzzer.

When the device was first completed, Dr. Witcher was puzzled by tricks played on him by puddles and ice. Neither of these reflected enough light to prevent the alarm from buzzing. He increased its sensitivity so that puddles and ice did not confuse the instrument.

Then it was too sensitive, he said. The shadow of a picket fence or the shadows cast by tree leaves triggered the alarm. Now he is searching for "the happy medium", where trees and fences will not say "Step down!" to the blind user, nor will mud puddles and ice.

BLIND TESTERS ENTHUSIASTIC

To get the "feel" of the Signal Corps device, Prof. Benham called in 67 blind or near-blind subjects to give the obstacle detector a workout over a period of time.

The subjects were enthusiastic over the device, making such comments as "much better than a cane; the instrument needs improvements and then it will be wonderful".

Prof. Benham is trying to make the improvements suggested. The latest, transistorised model now nearing completion uses a pulsed gas-discharge lamp with relatively small power demands. Modulated light reflected into the optical system of this instrument causes the handle to vibrate a warning. Eventually Prof. Benham wants to perfect a system using little pins in the detector's handle.

The number and location of the vibrating pins would tell the user how near the obstacle is and whether it is in front or to one side of him.

When these two instruments, the step-down indicator and the obstacle detector, are combined into a single unit, the blind should have a new, marvellous tool at their command. Even so, the two scientists warn that it will have its limitations.

They both should know. Each has been blind virtually since birth.

—SCIENCE NEWSLETTER.

ROCKETS mounted on the unswept wings of a training plane have successfully rescued the craft in tailspin tests.

Sanger M. Burk jun and Frederick M. Healy, both of Langley Aeronautical Laboratory of Langley Field, Va., reported to the National Advisory Committee for Aeronautics that the results of a test involving an actual plane closely matched those of wind tunnel tests. A scale model of the trainer was used in the indoor tests.

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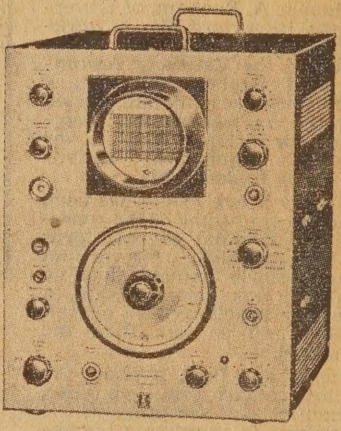
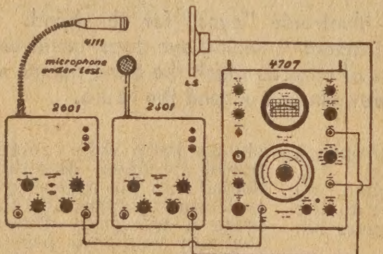
VISUAL RECORDING OF MICROPHONE AND LOUDSPEAKER CHARACTERISTICS

by means of
FREQUENCY RESPONSE TRACER 4707



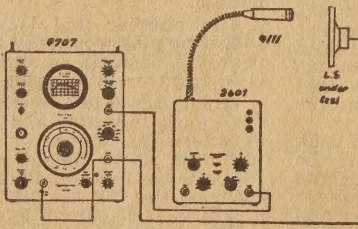
Frequency Response Tracer Type 4707 is specially designed for visual testing of acoustical equipment when it is preferable to have the equipment subjected to constant sound pressure, voltage or current. For this purpose it has a compressor stage to the B.F.O. section, so that the level will hold constant to 1-2 db over a range of 45 db, with a high regulating speed.

SPECIFICATION — Combined Beat Frequency Oscillator with compressor circuit and cathode ray oscillograph with long persistence 5 in. screen. The X-deflection is in synchronism with the motor-driven frequency sweep of the oscillator, sweeping the range from 20-20,000 c/s, 3, 6 or 12 times/min. The Y-deflection amplifier has a logarithmic response over 50 db. Frequency response of regulating amplifier better than ± 0.5 db from 50 to 20,000 c/s. Frequency response of oscilloscope component: linear to 0.5 db from 50-20,000 c/s. Telephones, microphones, loudspeakers, earphones, amplifiers, transmission lines, etc., can be examined visually.



VISUAL RECORDING OF MICROPHONE CHARACTERISTICS

The microphone under test is held in a constant sound pressure field by means of the regulation by the compressor in 4707, the input to the compressor coming from Standard Microphone 4111 via amplifier 2601. The output from 4707 to the loudspeaker then regulates any fluctuation in sound pressure at the microphone.



VISUAL RECORDING OF LOUDSPEAKER CHARACTERISTICS

Here, the loudspeaker is under test, the Standard Microphone (calibrated) supplying the recording signal. The compressor control provides a constant voltage to the loudspeaker by the coupling from output to compressor input.

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SOME SPACE TRAVEL PROBLEMS

Some facts and figures which throw light on the tasks ahead of scientists who still dream of making journeys into outer space.

By "PHYSICIST"

MOST of us would like to take a trip to the moon, and, of course, every one of us has a vivid mental picture of the space ship which is going to take us there. Have we not seen it colorfully displayed in magazines, comic strips, and on the films?

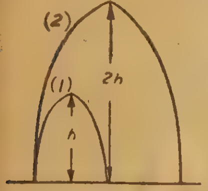

Fig. 1—(1) Stone thrown with velocity v rises to height h. (2) Stone thrown with velocity 2v rises to height 2h.

To be sure, it will be long and narrow, with big fins at the rear and spurting a long trail of flame, smoke, and hot gases, while we, the passengers and crew are comfortably installed in the pressurised air-conditioned cabin in the nose of the ship.

We shall be able to look through protective glasses, back to old mother earth as she recedes from us at the alarming speed of 25,000 miles per hour, or perhaps, look out into the blackness of space, relieved by the brightly shining planets and stars which are only overawed by the intense brilliance of the sun.

This story has been told many times now, and the sequence of events is familiar to everyone. It is hardly worth continuing here! Instead, let us, metaphorically speaking, come right down to earth from these flights of fancy and face cold, hard facts.

EARTH'S GRAVITATIONAL FIELD

A stone thrown into the air loses speed as it rises and ultimately returns to the earth, reaching it with the same speed with which it was thrown (ignoring the effects of air resistance). The faster it is thrown into the air the higher it will go before returning to the ground (Fig. 1).

The reason for this behavior is well known and is commonly referred to as being due to gravity, but what is not so easily appreciated is that the effect of gravity (or to put it more scientifically, the strength of the earth's gravitational field) decreases with the distance from the earth.

Therefore, as the stone is thrown higher and higher, the force on it due to gravity becomes smaller. Theoretically, it would be possible to throw the stone with such a speed that it rose to a height where the effect of gravity was very small, and its speed at that point was sufficient to overcome all the residual effect of gravity. Such a stone would never return to the earth!

It is quite a simple matter to calculate the speed with which the stone or any other projectile would have to be thrown, to escape from the earth. This speed is approximately 25,000 miles per hour (seven miles per second), and is often referred to as the "escape" velocity In no way does it depend upon the size or mass of the projectile.

The basic problem of space travel can thus be quite simply stated as the attainment of speed of 25,000 mph. Once the projectile reaches this speed at some point in its flight from the earth, it will inevitably free itself from the gravitational attraction of the earth. While the basic problem can be so simply expressed, however, its solution still eludes us.

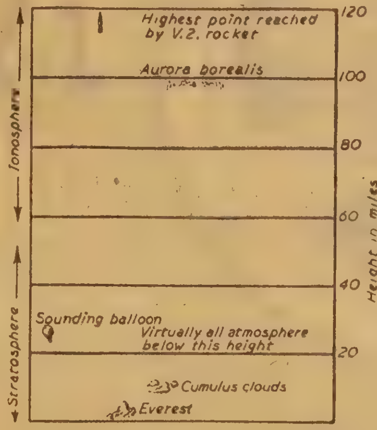

Fig. 2—The earth's atmosphere and space.

ACHIEVING ESCAPE VELOCITY

It is almost 100 years since Jules Verne postulated a "moon gun" which would fire a cannon ball with a passenger to the moon, but such a project could never become a practical proposition because of the enormous dimensions the gun would have, even if the projectile were fired from a height of several thousand feet, to escape most of the extremely high air resistance which would be exerted on it as it left the gun nozzle, travelling at 25,000 mph.

Fortunately, there is a possible alternative in the rocket which does not attain its greatest speed at the start of its flight. In fact, it is quite easy to start at a low speed and maintain this until it has cleared most of the earth's atmosphere, when the full thrust can be developed.

It is helpful to remember that the rocket motor does not rely on the atmosphere to develop maximum efficiency and that the rocket moves forward, due to the reaction force produced by the efflux of the hot gases from the combustion chamber.

MASS RATIO OF ROCKET

The size of the rocket is not in itself an indication of what the rocket can do. Naturally, a larger rocket will develop a larger thrust than a small one, but the important characteristic is the ratio between the weight of the rocket and the weight of the fuel it can hold.

Obviously the greater amount of fuel in a rocket of a certain mass the farther it can go. It is useful to express this relationship by the ratio.

$\frac{M_T}{M_R}$ where M_T = mass of the rocket at take-off, and M_R = mass of the rocket without fuel, and this is usually called the "mass ratio."

Exhaust Velocity

In rocket motors the thrust is produced by the rapid liberation of gases which stream forth from the combustion chamber with a certain velocity which is known as the "exhaust velocity". Knowing the limitations inherent in the design of rocket motors, it is possible to calculate a theoretical value for the exhaust velocity for any fuel whose chemical constitution is known.

With the best possible fuel known to date, viz., a mixture of hydrogen and oxygen, the exhaust velocity will not be much greater than 5000ft per second, and there are very serious drawbacks which have precluded the use of this fuel. For all practical fuels the exhaust velocity is never likely to exceed 4000ft per second, and 5000ft per second is about all that can be hoped for.

The importance of having a high

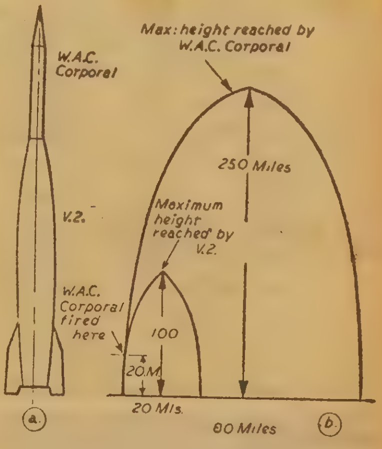
W.A.C. Corporal
V.2.
W.A.C. Corporal fired here
Max: height reached by W.A.C. Corporal
250 Miles
Maximum height reached by V.2.
100
20.M.
20 Mls.
80 Miles
a.
b.

Fig. 3—(a) Outline of a two-step rocket which rose to 250 miles. (b) Paths in space taken by the components of this rocket.

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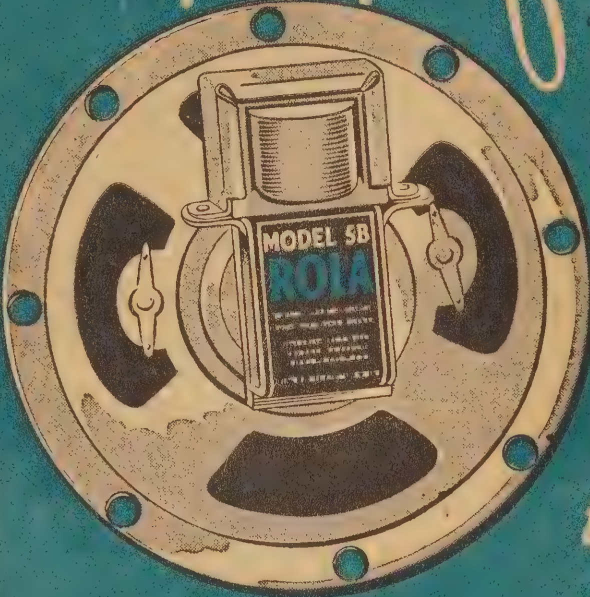

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SPECIFICATIONS

Power handling capacity	*2½ watts*
Diaphragm resonance	*150 c.p.s.*
Frequency response	*145 c.p.s. — 6.5 K.c.*
Voice Coil Impedance	*3.5 ohms at 400 c.p.s.*
Principal dimensions:	
Housing diameter	*5"*
Baffle opening diameter	*4"*
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exhaust velocity can be demonstrated by the following formula, which relates the mass ratio to the exhaust velocity c, and the rocket velocity v.

$$\frac{M_T}{M_R} = e^{v/c}$$

Now, remembering that for the rocket to escape from the earth, it must attain a velocity of 7 miles per second (=40,000ft per second approx), and assuming that the highest practical value for the exhaust-velocity using chemical fuels is 8000ft per second, it follows that

$$\frac{M_T}{M_R} = e^{\frac{40,000}{8,000}} = e^5 \bumpeq 148.$$

This is, if anything, somewhat of an underestimate because of the high value we assumed for the exhaust velocity.

Mass Ratio for a One-step Rocket to Escape From the Earth

The value for the mass ratio derived above implies that for a one-step rocket weighing one ton a fuel load of 147 tons would be necessary to ensure its escape from the earth. Clearly, this is far beyond the realm of engineering endeavor; in fact, anything with a mass ratio much in excess of 5 : 1 would prove impossible to build.

The V2, which was, from the German point of view, one of their most successful rockets, had a mass ratio of 3 : 1 and a total weight of 12 tons.

Exhaust Velocity for a One-Step Rocket of Mass Ratio 5 : 1 to Escape From the Earth

If we accept the limitation imposed by the constructional difficulties and say that the mass ratio cannot exceed 5 : 1, the exhaust velocity necessary to give the rocket a velocity of 40,000ft per second, reaches the fantastic figure of 25,000ft per second, which is some five times higher than present practical exhaust velocities.

Atomic-powered Rocket Motor

What hope is there then for a rocket to escape from the earth? Suggestions have been made which entail the use of an atomic reactor to provide electrical power, which would accelerate gaseous atoms to 300,000ft per second, but there are no grounds whatsoever for assuming that this is even a probability.

We are, therefore, forced to the conclusion that a one-step rocket will never be fired from the earth's surface and escape from the earth, using any known chemical fuel.

Multi-step Rockets

There are, however, possible ways of overcoming this difficulty. One is, by the use of a multi-step rocket built from several separate rockets, arranged so that the remaining steps are fired out of the last step in succession, as the maximum velocity for each step is reached. In this way, velocities greatly in excess of the exhaust velocity can be reached—but only at a price, for each subsequent step must be considerably less in mass than the preceding one, or the overall weight of the rocket becomes enormous!

A step rocket has not yet been constructed which can escape from the earth, but it is expected that a small rocket, the final step weighing no more than a few pounds and boosted by two further steps, will be fired to hit the moon within the next 50 years.

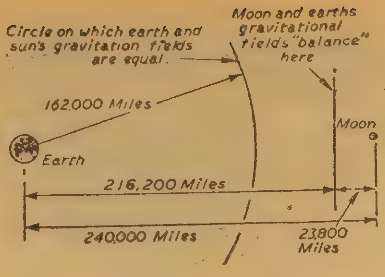

Circle on which earth and sun's gravitation fields are equal.
Moon and earths gravitational fields "balance" here
162,000 Miles
Moon
Earth
216,200 Miles
240,000 Miles
23,800 Miles

Fig. 4—Distribution of gravitational fields of earth and moon. A rocket form the earth is attracted back to the earth until it crosses the vertical line, then it is attracted toward the moon.

There are high hopes that its impact with the moon will be observed from the earth by placing a small explosive charge in the nose of the rocket which will scatter a white powder about a part of the moon's surface.

Oberth has calculated that a manned space-ship to reach the moon would comprise a three-step rocket and would be approximately 500ft long and between 30 and 40ft in diameter.

TWO-STEP TRIALS

Recent tests carried out at the White Sands Rocket Range in New Mexico show how some of the problems of multi-step rocket design are being met.

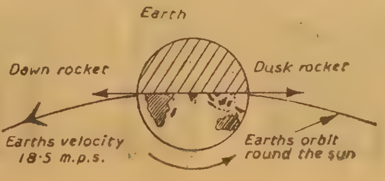


Fig. 5—Showing how the earth's velocity may be utilised in space travel. (a) For a rocket launched vertically at dawn, resultant velocity is the sum of its velocity relative to the earth and the earth's velocity; this rocket will move in a smaller orbit than the earth. (b) For a rocket launched vertically at dusk, resultant velocity is the difference of its velocity relative to the earth and the earth's velocity; this rocket will move in a larger orbit than the earth.

A two-step rocket made of a modified V2 weighing 12 tons and a much smaller rocket, the WAC Corporal, weighing 6cwt and of which only 25lb was payload (instruments) has been fired to a total height of 250 miles, before crashing back to the earth, Fig. 3. The total time of flight was 12min. The V2 was fired at ground level and the WAC Corporal was launched from it when it was 20 miles high and travelling at approximately one mile per second.

Further tests have been made, presumably to study the effects of cosmic radiation on materials, and small animals, suitably anaesthetised, have been carried. As far as is known, they have suffered no ill-effects from their flight into space. In later tests, a height of over 300 miles has been reached and a film record of the appearance of the earth was made during the flight.

THE EARTH SATELLITE

These investigations have formed part of a program announced by the United States Secretary of Defence in 1948 and known as the Earth Satellite Vehicle Program. The declared objective being the developments of small rockets to travel in fixed orbits around the earth.

The idea of a man-made projectile travelling around the earth is its own orbit, at first sight appears fantastic, until it is remembered that, after all, the moon is merely a satellite of the earth and it moves continuously in a fixed orbit. The earth also is a satellite of the sun, moving in its orbit at 18.5 miles per second.

Provided that the rocket could be fired with sufficient velocity to clear the earth's atmosphere and directed so that its direction of motion became tangential to the earth's surface, it would ultimately travel around the earth and in the absence of the frictional resistance of the atmosphere, it would continue in its orbit indefinitely.

The mathematical relationship between the diameter of the orbit and the velocity of the rocket can be simply and accurately deduced, so that the rocket can be designed to travel in any selected orbit, provided it is outside the limit of the earth's atmosphere.

Naturally, such a rocket would be used as a "space laboratory", crammed with instruments, their reading being transmitted by radio to the earth. In this manner, a welter of information about the conditions in space would quickly be amassed.

To the more ambitious minded devotees of future space travel, this experiment is looked upon as merely the opening phase in the development of a space-ship station to which fuel and men would be ferried from the earth by rocket, so that interplanetary rockets could refuel there without returning to the earth.

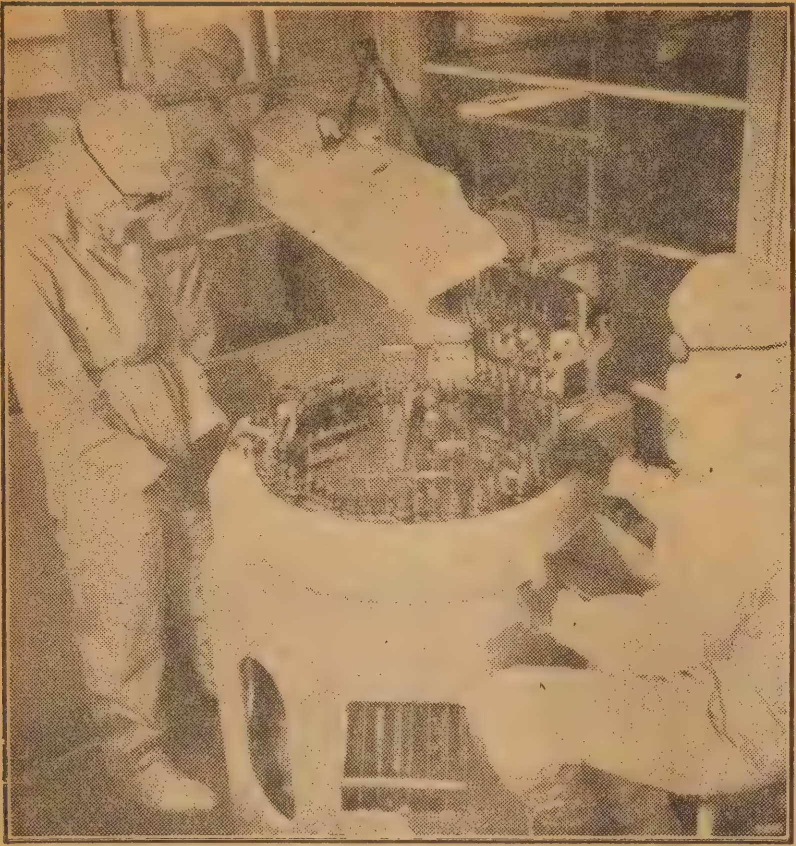
Admittedly, in this way, larger rockets would be able to escape from the earth, but the engineering problems involved in assembling the satellite space-station are virtually insuperable and whether it will ever become a reality is, to say the least, highly conjectural.

PLANETARY TRAVEL

Surprising as it may seem, if manned space-ships can reach the moon, travel to the other planets should quickly follow, for it must be remembered, that the earth is moving at 18.5 miles per second around the sun, and that a rocket leaving the earth will also be travelling at this speed and by arranging the start of the trip to coincide with a favorable position of the earth with respect to the planet and starting the journey at the right time of the day, it should be possible to utilise a large part of this velocity, Fig. 5. The complicating factor here, is likely to be the time taken to make the trip, which will be several weeks or months at least.

Food for the trip would present no serious obstacle; tinned and bottled food should solve all the feeding problems of the crew and water

(Continued on Page 109)



Use of germ killing lamps fitted over an ampoule filling machine in order to prevent contamination of the penicillin with which they are charged. The whole room is irradiated by other similar lamps. The lamp used with the machine is housed under the reflector mounted above the machine.

STERILISATION BY LIGHT RAYS

Germs and bacteria flourish all around us. Sometimes they are useful and often they can kill. This article describes how special lamps can be used for sterilisation and to control the growth of unwanted bacteria.

by Calvin Walters

WHEN man first discovered that germs were the cause of disease, science commenced a constant war against these insidious foes and has devised many methods of killing them.

Since Lord Lister made his epoch-making discovery that germs could be killed with solutions of carbolic acid and other substances many gallons of these have flowed down the drain.

This constant war has led to the discovery of many substances which are commonly called antiseptics, and these are used at the present time in various ways.

CARBOLIC ACID

One of the earliest substances was carbolic acid, which has been combined with soap to kill germs in washtubs and also to prevent conditions about which your friends are reluctant to convey information to you.

During the years many new substances have been found until the numbers are now legion.

Among these can be mentioned boracic acid, chloride of lime, chlorine, permanganate of potash (Condy's crystals), mercuric chloride (corrosive sublimate), iodine, iodoform, formalin, eucalyptus oil, ti-tree oil, creosote, salicylic acid, thymol, sulphate of copper, chloride of zinc.

In fact, there are literally thousands of substances which will kill germs, but many of them are also poisonous to man and therefore cannot be used.

Alcohol is a very potent killer of germs and for this reason is a popular excuse for curing colds. For this purpose it is usually flavored in a variety of ways to produce whisky, rum, brandy or methylated spirit.

PICKLED FOOD

That is why we hear of people being "pickled", for pickling is a process whereby the actions of bacteria are considerably retarded and is used in preserving food.

Prior to the introduction of antiseptic surgery by Lord Lister the accepted method of conducting an operation was to hack off the offending limb with any dirty old saw or knife and wipe it afterward with any dirty old rag which happened to be lying around.

The result was that the operation was usually successful but the patient died from causes then unknown. Presumably he couldn't stand the strain, or didn't have enough faith, or something.

Lord Lister realised that germs were mostly the cause of death. His antiseptics saved millions of lives from his day to the present time.

Present-day technique has been considerably aided by the use of the so-called "wonder drugs", such as penicillin, streptomycin, aureomycin and the sulpha drugs.

USE OF DRUGS

These are the result of many years search for a substance which will inhibit the growth of germs in the human body. All the other substances mentioned are used externally.

Until the discovery of these "wonder drugs" it was not possible to deal efficiently with germs inside the body. Obviously one could not swallow an effective dose of carbolic acid to kill germs in the tummy without killing oneself.

During the years since the germ theory was propounded many nostrums have been inflicted on the public for the purpose of allegedly killing germs. These range from a variety of incantations based on the presence of devils who scatter bagfuls of germs around, the burning of incense of a variety of smells and the use of atomisers and sundry inhalants, many of which serve no other purpose than to irritate the ear, eye, nose and throat.

Louis Pasteur, of course, contributed greatly to the war against germs by his invention of the vaccine which is widely used at the present day with great effect. This of course does not kill germs but renders them impotent in the body.

The use of light as an effective weapon to kill germs was something which would have astounded these great men. Yet during the years in which they lived the "purifying" action of sunlight was known well enough although the reason was unsuspected.

Later studies showed that it is the ultra-violet ray content of sunlight which is the effective component.

ULTRA-VIOLET RAYS

In 1903 two workers—Bernard and Morgan—demonstrated that it is only the ultra violet rays of a certain wave-length which are the effective germ killers.

Before we proceed, let us get a clear meaning of an Angstrom Unit for this is the unit with which very short wave-lengths are measured. It is named after a noted Swedish physicist.

One Angstrom Unit is 10 to minus 7 millimetre, which is one ten-millionth of a millimetre. It is thus very short indeed.

Ultra-violet radiation falls into three main wave-length groups.

These are: (a) Long waves from 3150 to 4000 Ang. Units. These are the main ultra-violet rays from the sun and pass through most kinds of glass.

(b) Middle waves from 2800 to 3150 Ang. Units. These are used mostly for medicinal purposes and will pigment the skin. These also form vitamin D in the skin.

(c) Short waves below 2800 Ang. Units which have a very strong germicidal action and will cause irritation of the mucous membranes. These waves are absorbed by most kinds of glass.

The latter waves are those used for their germicidal properties and may be artificially generated in a number of ways mainly by very hot bodies and ionised gases.

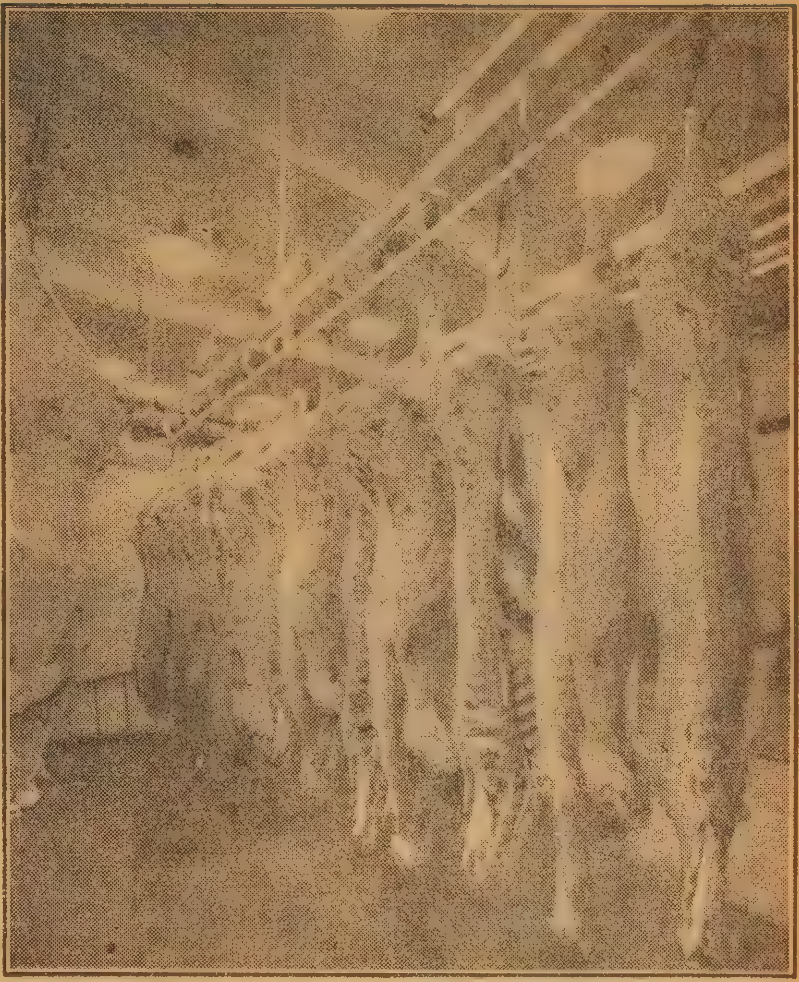
Any incandescent flame or solid is rich in ultra violet rays but the "hot" sources usually used are the iron arc, carbon arc, spark gap, mercury arc, high intensity vapor lamp and incandescent electric light globes.

The main source used today is the mercury arc contained in a quartz tube or in a special glass which allows the transmission of ultra violet light. Most kinds of glass absorbs rays below 3000 Angstrom Units. These are used for the elimination of the shorter rays and are used in the so called "sun" lamps.

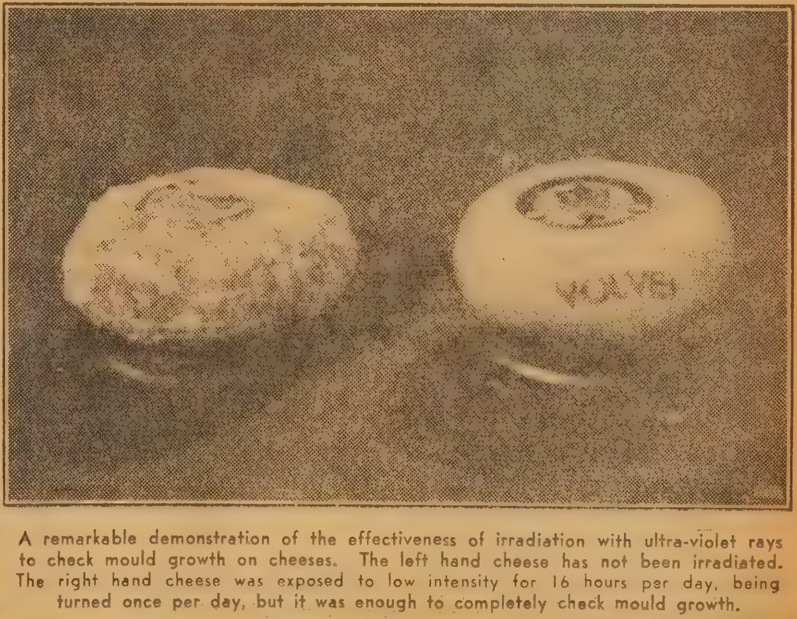
There are other glasses which allow the transmission of the short rays and these are used in the germicidal lamp.

The practical application of the germicidal lamp mainly concerns the destruction of bacteria in the air and on exposed surfaces.

The air in an enclosed room is



Lamps are often used in cold storage plants to inhibit the growth of bacteria and mould growth. Here a series of lamps are seen protecting meat carcases awaiting distribution.



A remarkable demonstration of the effectiveness of irradiation with ultra-violet rays to check mould growth on cheeses. The left hand cheese has not been irradiated. The right hand cheese was exposed to low intensity for 16 hours per day, being turned once per day, but it was enough to completely check mould growth.

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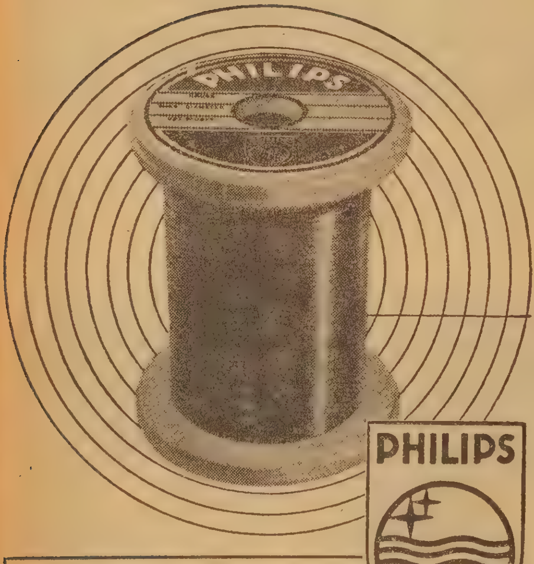

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usually very rich in bacteria which not only transmit disease but cause spoilage of foodstuffs.

The modern ultra violet germicidal lamp such as the Philips TUV lamp casts its rays throughout the air thus rendering it almost free from harmful bacteria. The beneficial effects of this fact is easy to realise. Its practical value is obvious in offices and factories where colds and influenza take a toll of the available man-hours.

Hospitals and operating theatres are ideal applications for this technique. Its use for this purpose is becoming widespread.

In the storage of food and the handling to which it is subjected the germicidal lamp provides an ideal and simple means for maintaining a sanitary storage and processing area.

MODERN LAMP

With the new TUV lamp germs are killed in ten seconds at a distance of six inches from a 30 watt lamp. The killing power varies according to the distance of the lamp from the germ. At a distance of 2ft from the lamp a germ will be killed four times as quickly as it will be at a distance of four feet.

An advantage of this technique is that all bacteria, virus and the notoriously hard-to-kill mould spores are vulnerable to the rays.

Solid substances are not penetrated by the rays so that food stuffs such as meat and cheese can only be sterilised on the surface.

The only disadvantage of the technique is the harmful effect on the eyes and skin from too direct exposure. This requires that, in storage rooms and other places where the worker may be exposed, goggles should be used as well as face shields. In offices and rooms it is usual to suspend the lamp from the ceiling above eye level. Only the upper air is sterilised, and being above eye level the rays have no harmful effects.

The modern TUV lamp looks somethink like an ordinary fluorescent tube except that it glows with a blue light. It is usually mounted in an anuminium reflector unit, for it has been found that aluminium when polished is 25 pc more efficient than polished tin or chromium in the reflection of the rays.

VARIED APPLICATIONS

The applications of the germicidal lamp are very varied and in some cases somewhat surprising.

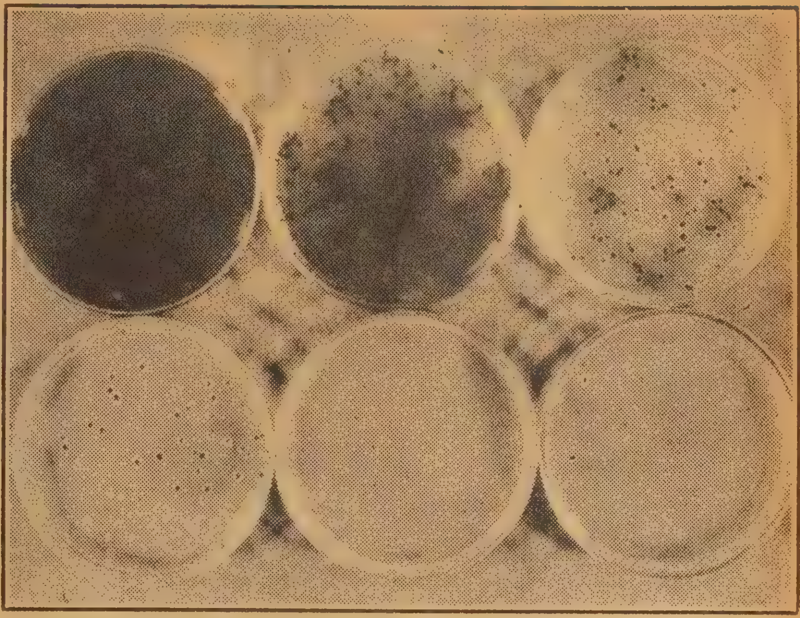
In the poultry industry the growth of chickens is promoted by ultra violet radiation, so that it is possible to have a bird weighing 3lb 12oz at twelve weeks old if it has been irradiated since hatched. This is a good thing for some when we have to pay 12/6 for a poultry dinner consisting of a wing and two baked spuds.

The same applies to eggs at 6d each. Ultra-violet irradiation of the pullet increases the thickness and weight of the egg and increases egg production and hatchability to a very great degree.

The lamps are today installed in incubators and hatcheries, brooder rooms and laying houses so that poor old biddy doesn't get much rest nowadays.

One of the great putrefiers of meat and other food are the air-borne spores which settle on the surfaces. These produce slime and bad smells.

BACTERIA GROWTH IS CHECKED



Development of bacteria due to injection from the air. Top row—in a space where no lamp was burning. Bottom row—germicidal lamp switched on immediately after atomisation of bacteria in the air. From left to right—2.5 and 15 minutes after atomisation.

The usual method of preservation is to place meat and foods in a refrigerator. This is very effective but has the advantage that low temperatures reduce the humidity of the air and cause the food to dry out. This is a common complaint in the household refrigerator. By the use of germicidal lamps in refrigerators the temperature can be raised from the usual 36 degrees to that of 42 degrees and the usual humidity of 70 pc can be raised to 95 pc.

This technique prevents the food from drying out and makes meat more tender, and in the case of refrigerator failure the loss is considerably reduced.

In bakehouses the control of bacterial invasion is very important. Mould and the disease called "rope" can be very serious. The high humidity in a bakehouse and the accumulation of floor dust make it difficult to have constant cleanliness no matter how great the effort.

Intensive ultra-violet irradiation has a most marked effect in prevention of these moulds. The walls and ceilings can be treated constantly and the flour and dough submitted to the technique.

Further treatment after the bread leaves the ovens ensures that any spores and bacteria which fall on to the bread are done away with.

If the bread is wrapped, treatment of the bread and the wrapping sterilises the two to the extent that the bread retains its flavor and lasting qualities for a much greater period. Even slicing and wrapping machines can be simply sterilised by installing a lamp in close proximity.

In the making of cheese the ripening depends on the action of certain bacteria inside the cheese. After moulding, the cheese is put into a ripening chamber, and to prevent the formation of moulds on the surface, this is regularly cleaned and oiled.

It is no longer necessary to carry out this cleaning and oiling for a a continuous irradiation with ultra violet effectively controls this unwanted mould growth.

MILK INDUSTRY

The milk industry will benefit greatly from the use of germicidal lamps. Milk and cream are ideal medium for the growth of bacteria, and milk becomes readily contaminated from airborne bacteria.

A layer of milk three thousandths of an inch thick will absorb 90 pc of the ultra violet falling upon it. Thus treatment of the milk, while being agitated will ensure complete sterilisation. Likewise if the bottles are treated with the lamps from the time they are washed to the time they are filled and capped, pasteurisation is unnecessary as the milk would be absolutely sterile.

As with milk, so with beer, and some kinds of cordials. While these are wide apart as beverages they all are subject during manufacture to contamination by moulds. These not only grow on the surface, but will grow inside the liquid, which spoils the flavor and explains a lot of things. Treatment with ultra violet will prevent this.

PHARMACEUTICAL USE

In the manufacture of pharmaceutical preparations it is essential that sterilisation be sometimes complete. Here again ultra violet does a most effective job.

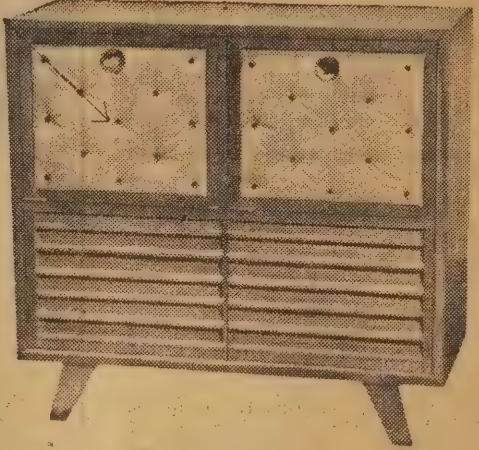
Surgical operations are being carried out under the glow of the ger-

(Continued on Page 81)

AUTOMATIC RADIOGRAMS

Designed for today

NEW YORKER - C85



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- 3 speed automatic record changer — plays 7in, 10in and 12in records.
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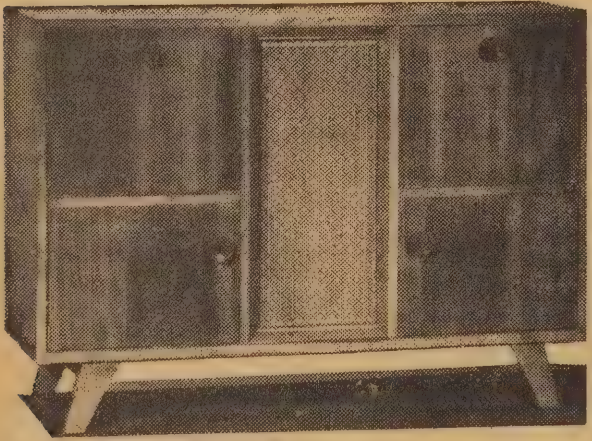

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Special features of this model—

- 3 speed record changer
- Dimensions: 48in wide x 35in high x 18in deep
- Expanded aluminium grille.
- 2 large storage compartments for records and/or glassware or bottles

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Technical Review

Mobile f-m transmitter powered by sun's rays falling on developmental silicon solar battery has possible range of several miles.

SUN POWERS RADIO TELEPHONE

Scientists were never more active in probing the possibilities of new developments than at the present day. The rewards are likely to be so great and the competition is so keen that no idea is considered to be impracticable. The fantastic of today is the reality of tomorrow.

SOURCES of cheap power have high priority in research. Industry is painfully aware of the fact that some day its huge demand on the world's resources of power will become excessive, and will no longer be met.

This is the main interest in this extract from Electronics in which the sun's power is used to energise a new type of battery.

Low-power demands of transistorised telephone equipment and development of p-n junctions in silicon have made feasible a practical solar battery.

The battery illustrated comprises a number of silicon strips each measuring about a half inch by two inches, which when connected together, produce power from sunlight at a rate of 50 watts per square yard of surface.

Heart of the development is a technique, useful in the manufacture of transistor devices, of introducing controlled amount of impurity beneath the surface of extremely pure silicon. Introduced at a precise rate under carefully controlled conditions, the impurities reach a depth of less than one ten-thousandth of an inch.

Wires, through which useful current may flow, are connected to the surface layer and to the body of the silicon. In full sunlight, current flows at a rate of 24 milliamperes per square centimetre at a voltage of approximately half a volt. In practice, the silicon strips, which can stand much higher temperatures than comparable germanium devices, are encapsulated in a clear high-resistance plastic.

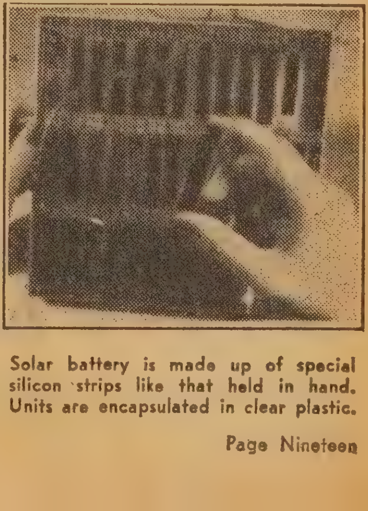
Bell Labs scientists estimate that this type of energy conversion unit, operating on the light rather than the heat of the sun, can never convert more than 22 pc of total incident solar energy. They believe that it may be possible to attain practical efficiencies as high as 10 pc. The present solar battery has an efficiency of 6 pc, which is many times that of comparable devices, such as thermocouples and photocells.

Although many interesting experiments can be performed with the solar batteries constructed in the laboratory, using either sunlight or artificial illumination, they are not yet in a stage of development for high-power applications.

First practical employment of the sun for telephone service may be with transistor equipment now undergoing field tests near Americus, Ga. Prime source of power must be storage batteries, as is true generally in telephone plant. By determining the probable incidence of sunshine a solar battery of sufficient size may be installed to keep the storage battery charged. This solar battery would probably have from three to five times the energy of one required for service under continuous illumination.

At a recent demonstration, the solar battery was used to power a portable transistor f-m transmitter and turn the motor to run a toy ferris wheel.

Bell Labs' research team, G. L. Pearson (physicist), D. M. Chapin (engineer) and C. S. Fuller (chemist), who invented the solar battery, check samples for photo-electric efficiency.



Solar battery is made up of special silicon strips like that held in hand. Units are encapsulated in clear plastic.

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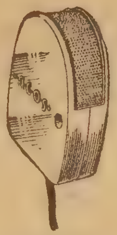

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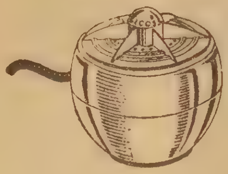
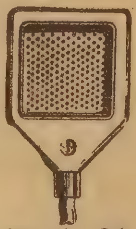
(HAND/DESK)
PRICE £2/15/‹



MODEL 33
(DESK)
PRICE £6/18/6



Front view Only

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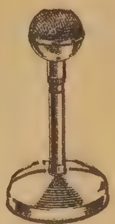
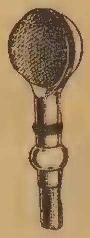


MODEL 22
(HAND/DESK)
PRICE £9/18/6



MODEL 16
(HAND/FLOOR)
PRICE £26/19/6

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TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.3-2	General Purpose	1¾in dia. x ⅜in thick	20db Peak at 2500 C.P.S.	Mona	£1 19 3
MIC.3-5	" "	" " " " "	12db " " " "	Mervyn	1 19 3
MIC.3-6	" "	" " " " "	5db " " " "	Myrtle	1 19 3

MIC. 6 SERIES

TYPE	DESCRIPTION.	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.6-4	General Purpose	2 1-32in dia. x 19-32 thick	20db Peak at 2250 C.P.S.	Margie	£1 19 3
MIC.6-6	" "	" " " " "	5db " " " "	Maudie	1 19 3
MIC.6-11	" "	" " " " "	12db " " " "	Mandy	1 19 3

MIC. 14 SERIES

TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.14-5	General Purpose	1 7-16in dia. x 11-32in thick	20db Peak at 3500 C.P.S.	Maxie	£1 19 6
MIC.14-11	" "	" " " " "	12db " " " "	Mitchell	1 19 6
MIC.14-12	" "	" " " " "	5db " " " "	Malcolm	1 19 6
MIC.15	Hearing Aid	0.9in dia. x 0.155in thick	30db " " 3000 "	Marlene	1 19 6
MIC.17	" "	15-16 in sq. x 7-32in thick	30db " " 3500 "	Maggie	1 19 6
MIC.18	General Purpose	1 7-16 in dia. x 9-32in thick	20db " " " "	Maisie	1 19 6

MIC. 23 SERIES

TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.23	General Purpose	1 3-16 sq. x ¼in thick	20db Peak at 3000 C.P.S.	Maureen	£1 19 3
MIC.23-3	" "	" " " " "	5db " " " "	Margaret	1 19 3
MIC.23-4	" "	" " " " "	12db " " " "	Milton	1 19 3
MIC.32	High Quality	1 13-16 dia. x 9-16in thick		Martin	2 15 6

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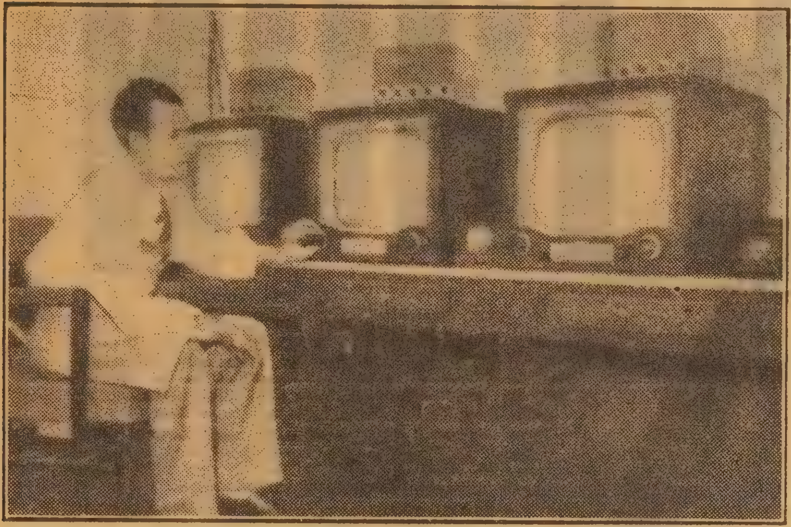


California market owner has installed three small television cameras (like that near ceiling at right) to scan 22,000 square feet of floor area. Shoplifters can be detected by viewing displays on three receiver screens (at left). Each camera is suspended four feet below ceiling and can be completely rotated or turned downwards at 45 degrees. Controls are located at the receivers. — (Electronics)

SIMPLE SQUARE WAVE CIRCUIT

A relatively simple, one-tube clipper circuit has been designed which is capable of developing square waves by properly shaping a sinusoidal input waveform.

BASICALLY the circuit consists of a high-speed, cathode-coupled bistable multivibrator known as the Schmitt trigger circuit.

In Fig. 1, the grid of the first triode V1A is connected to a dc voltage source which can be varied in amplitude. When this voltage is zero V1A is nonconducting. The plate voltage is direct-coupled through a frequency compensated voltage divider, R3, R4, and C1, to the grid of the second triode causing V1B to conduct. When the grid voltage of V1A approaches a voltage equal to the cathode potential minus the grid bias, V1A starts to conduct. At a slightly higher voltage, a critical point is reached and regeneration takes place causing a sudden transfer of current from V1B to V1A. In this second state, V1A is conducting and V1B is cut off.

As the grid voltage is reduced no change in state will occur until the input voltage approaches a second critical potential. A regenerative condition again results, and the circuit returns to its previous stable state with V1A cut off and V1B conducting.

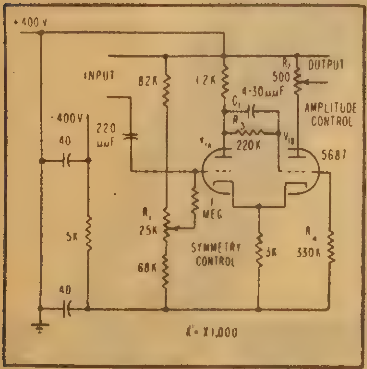


FIG. 1—Generator uses Schmitt trigger circuit to produce square waves from sine-wave input.

RECTANGULAR WAVE

By introducing a varying waveform at the grid of V1A it is possible to develop a rectangular waveform at the plate of V1B. The signal to be clipped is coupled to the grid through a large blocking capacitor. Any waveform may be used at the input to provide a rectangular waveform of constant amplitude at the output.

With the parameters indicated, a waveform having a peak-to-peak amplitude of approximately 5 volts is required to trigger the circuit. The input impedance is 1 megohm. Maximum output waveform amplitude is approximately 20 volts peak-to-peak. The output impedance varies from zero to 500 ohms depending on the setting of the amplitude control. A negative power supply is used so that no output coupling capacitor is required. This feature is necesary if long pulses with perfectly flat tops are to be obtained.

RISE TIME

The measured rise time between 10 and 90 pc amplitude points of the output wave-shapes is 0.25 microsecond. It is important that the 3000-ohm cathode resistor be non-inductive. If a wire-wound resistor is used, the rise time of the output waveform will be greater than specified.

Two controls are included in the design. Symmetry control R1, varies the d-c bias applied to the grid of V1A. When a sine wave is applied to the input grid, it is possible to obtain an asymmetrical output waveform, the duty cycle of which may be varied from 20 to 80 pc.

The amplitude control R2, varies the amplitude of the output waveform from 0 to 20 volts peak-to-peak. The device is capable of developing square waves varying in frequency from 20 to 200,000 cycles.

Figure 2 shows the output waveforms obtained with sine-wave input signals. Effect of capacitive loading is also shown. Pulses as short as 1 microsecond can be obtained with a repetition rate of 200Kc.

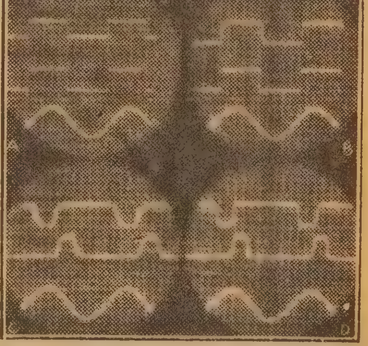
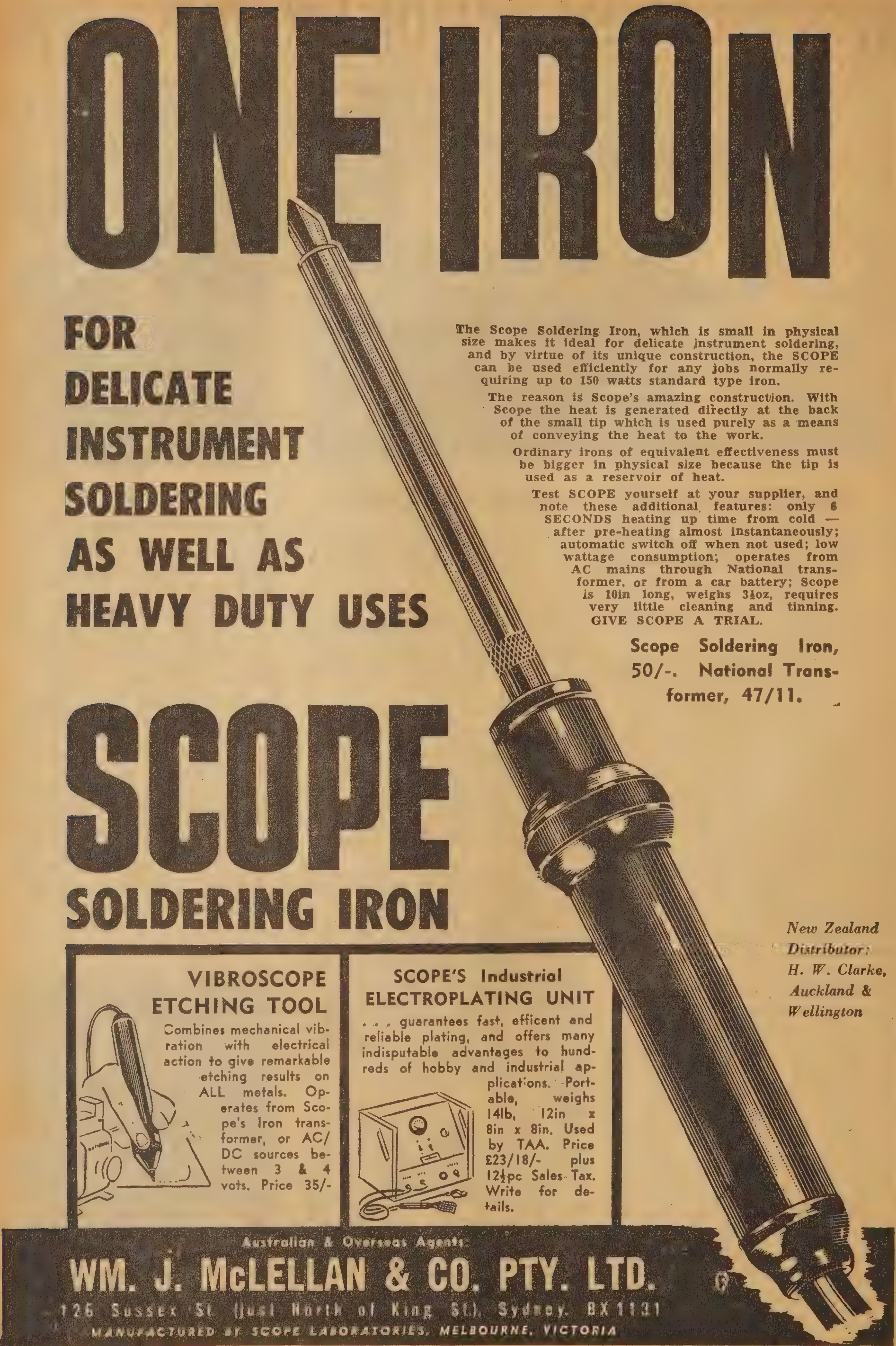


FIG. 2—Output waveforms obtained using a 20 cps input (A), 10 kc input (B), 200 kc input (C) and 200 kc with capacitive loading (D).



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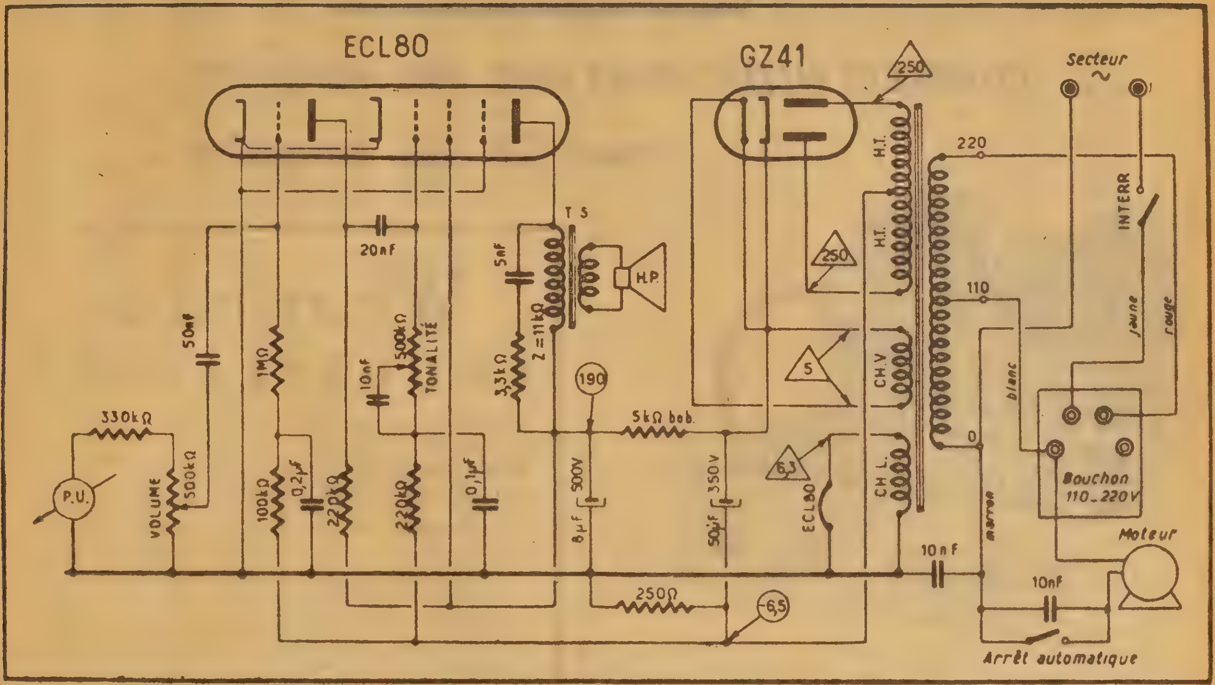

Figures inside triangles are AC voltage readings; those inside circles are DC readings.

From the French radio magazine TSF et TV comes an amplifier circuit which should be of special interest to readers interested in building for themselves a portable electric phonograph. Though using only one valve and a rectifier, it has two active amplifier stages.

HEART of the amplifier is the triode-pentode type ECL80, which is sold in this country under the same type number or under the RMA number, type 6AB8.

Though originally intended for use in television receivers, the valve also has useful audio characteristics and can be used in cascade with the triode as a voltage amplifier and the pentode as an output stage, feeding the speaker.

The triode has an amplification factor of 17.5 and, under the conditions shown in the above circuit, gives a stage gain of about 11 times and an RMS output voltage of 30.

Published figures for the pentode section indicate that it has a normal plate and screen rating of 200 volts, a cathode current of just over 20 milliamps and an output of 1.75 watts, delivered into an 11,000 ohm load.

While this is not equal to the output of types like the 6M5 and 6AQ5, it is nevertheless adequate for listening at moderate volume in ordinary homes.

The amplifier, as shown above, is intended for use in a portable electric phonograph, along similar lines to the Radio and Hobbies PortaPlayer, in the December, 1953, issue.

It assumes the use of a crystal pickup and the designers have provided for a 330,000 ohm resistor in series with the active end of the volume control. While reducing somewhat the output available from the pickup, this extra resistor would increase the net pickup load and lift the bass response as a result.

If gain is at a premium, it could obviously be omitted.

In most other respects the circuit is conventional, except perhaps the use of back bias on the input stage.

An unfamiliar notation is used for certain capacitance values but it is obvious enough that 10nF is .01 mfd., 20nF is .02 mfd. and 50nF is .05 mfd. Various other French abbreviations should not present any great difficulty to readers familiar with circuits and "high school" French.

The GZ 41 is not a very familiar type in this country but this should not cause any difficulty.

WE can still supply handsome covers to hold 12 issues of Radio and Hobbies. Red leatherette with gold lettering, copies held on individual tapes, no piercing of pages. Send 14/- plus postage (1/- within 30 miles of Sydney, 1/6 elsewhere). Radio and Hobbies, 60-70 Elizabeth St., Sydney.

If the transformer used has a 5.0 volt winding, a 5Y3-GT could be used as rectifier, the HT output being taken from one side of the filament in the usual way.

Where all valves have to be operated from a single 6.3 volt winding, a 6X4 or 6V4 would be the obvious choice. In this case the HT output would be taken from the cathode and no connection made between cathode and the heater circuit.

The mains wiring looks complicated, because it takes into account the "off-on" switch (on the volume control), the voltage selector panel, the automatic stop (on the base of the pickup) and the wiring to the motor.

The motor is presumably a 110-volt type which is connected permanently across portion of the transformer primary winding. For 110 volt mains, the input is directed to these same two points but, for higher voltages, the mains are tapped along the transformer primary alone, so that it acts as an auto-transformer to operate the motor.

Diagrams in the magazine indicate that the amplifier is assembled on a long, narrow chassis, with the large components arranged more or less in a single line. This chassis is mounted on its side in the cabinet with the volume and tone control knobs protruding upward through the motor board and alongside the turntable.

The speed control knob is also located nearby for convenience of operation.

The speaker is a 17cm. permagnetic type, mounted on the lid of the case. The designers claim that the output from the amplifier and speaker is quite adequate for use in flats and apartments.

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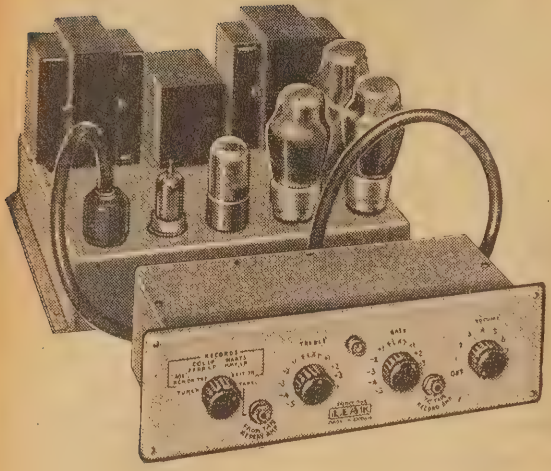

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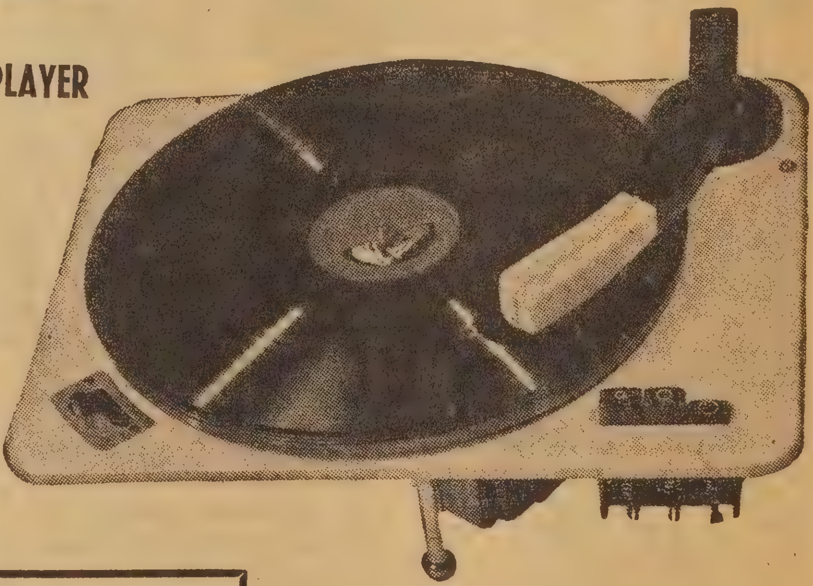

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NEWS AND VIEWS OF THE MONTH

Water-proof Radio

THE Australian Army's new man-pack radio recently demonstrated that it can operate successfully under water, in an aircraft at 25,000ft and in temperatures ranging from minus 40 to plus 85 degrees C.

The tests were carried out at French's Forest, where an army signaller waded through a creek while operating.

The radio transmitter-receiver is intended to be carried by one man in the field and will replace older types of heavier and less efficient equipment. It weighs only 22lb with batteries and is carried in two pouches strapped to the signaller's chest. It was designed and built by AWA.

* * *

Plastic Car Bodies

ALTHOUGH plastic car bodies are coming nearer, they may never replace steel for ordinary production models. But experiments are being made with limited production of plastic-glass bodies in USA.

The plastic bodies are five times as costly as steel although tooling up for steel bodies is 10 times dearer.

Car manufacturers think plastic cars will boost sales.

Plastic cars are show cars designed to bring buyers of standard cars into the showroom.

This year General Motors is making 10,000 low-slung sports Corvettes and Kaiser Motors are making 2000 Darrins with plastic bodies.

They think these cars will have a promotion value far beyond their intrinsic worth.

Dodge, Plymouth, Ford and Packard have plastic-bodied cars at the prototype stage.

By making the Corvettes General Motors is hoping to confirm its guess that 15,000 units is the dividing line between the cost of steel and plastic.

The company thinks that any production run of fewer than 15,000 units would be cheaper to make in plastic.

* * *

Heavy Water Project

BRITAIN and New Zealand will be partners in the production of "heavy water".

They will make the "heavy water" in New Zealand's geo-thermal areas, according to New Zealand Prime Minister (Mr. Holland).

Heavy water is an essential ingredient to the production of uranium.

Britain's only source of "heavy water" now is Scandinavia.

The project was first suggested two years ago.

It will also include harnessing underground streams from the Rotorua thermal regions to produce electricity.

* * *

Blame the Moon

NEW ZEALAND geologists have a theory that volcanic activity is related to phases of the moon.

The geologists are camped near Mount Ngauruhoe, an active volcano in the middle of the North Island.

The NZ Government Geological Survey Division's geologist (Mr. Beck) said that geologists had discussed the theory since 1945.

Volcanic activity, on some occasions, had been close to or at the new moon.

Mr. Beck claimed that research into Ngauruhoe's eruptions since 1934 substantiated the geologists' theory.

* * *

Non-stop—and How!

A CAR whose many gadgets include equipment for changing tyres without stopping, recently commenced a non-stop run from Alaska to Mexico City.

The car has television, dashboard bar, fender, shower and back-seat toilet service — including hot water and electric razor.

The car will be refuelled on the run and the tyres changed by means of hydraulic jacks on wheels and an emergency catwalk for the manual work.

* * *

Uranium in Plants

TREES and bushes brought in from Rum Jungle and Adelaide River contained traces of uranium, said Mr. Debenham, geologist of the Bureau of Mineral Resources.

Mr. Debenham said plants could store uranium in the same way that they stored lead, copper and other trace elements.

Geologists had hoped to find uranium indicator plants such as searchers had found in the United States.

Mr. Debenham said it now seemed unlikely searchers would find such a plant in Australia.

Botanists now sought plants which grew everywhere, and had the power to absorb uranium through their roots.

POPULAR SCIENCE QUIZ

Q.: Can the iron content be recovered from "pickling" baths?

A.: Yes, by a new process which involves an ion exchange in the waste water from industrial plants using acid to clean the surface of steel products. The yield of iron from this treatment, which proceeds atom by atom, is measured by the pound.

A variety of plastic resins is available that draws the iron out of the waste water solution trickling through the ion exchange apparatus. A particular kind of resin, known as a quaternary type anion exchanger can be made to take iron out of hydrochloric acid solution and, simultaneously, recover the hydrochloric acid. This dual purpose accomplishment saves useful materials in a form not too expensive to use over again and prevents harmful wastes from polluting water supplies.

Sulphuric acid, a more common material than hydrochloric acid for cleaning or "pickling" steel, is recovered by a different type of ion exchange resin.

Q.: What is "technetium"?

A.: According to a new theory advanced by Dr. A. G. W. Cameron, of Iowa State College, USA technetium, element 43 in the chemical table of elements, is created in the stars by thermonuclear reactions. This element does not exist in stable form on the earth and is produced on this planet only by atomic bombardment as in the A-bomb and H-bomb.

Thermonuclear reactions are those in which the lighter elements are fused with an accompanying loss of mass which is converted into energy. Hydrogen feeds such a reaction in a giant star and when exhausted, the core of the star is thought to contract and the central temperature rise until thermonuclear reactions with helium take place.

At an absolute temperature of 100-million degrees, Dr. Cameron's theory predicts that a kind of heavy carbon of atomic weight 13, when bombarded with an alpha particle or helium atom, would create an oxygen atom and give off a neutron. The ready supply of neutrons thus generated would be captured by heavier elements in the star to change them into the kinds of elements that the spectra of light from the stars show to be present. Technetium would be among the elements formed in this way.

Q.: What is "cathodic protection" as applied to ships?

A.: While a plastic coating protects equipment and fittings aboard the "mothball fleets" of idle naval vessels, maintaining the hulls of these ships in a serviceable condition still involves the conventional dry-docking, scraping and painting, at considerable expense.

To protect the hull of each ship from corrosion due to reaction of the water, a system of "cathodic protection" has been created which causes a submerged metal "anchor" to corrode instead of the ship bottom. The ship forms one electrode in an electric circuit while the "anchor" forms the other. Direct current passed through the water between the "anchor" and the ship sets up an electrochemical reaction which achieves the objective.

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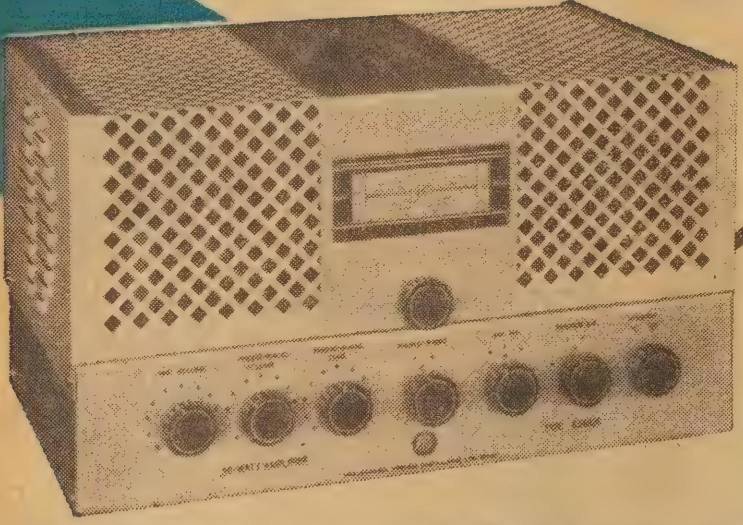
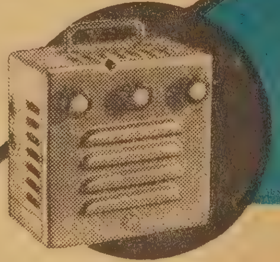
- **PICKUP RADIO VOLUME:** Controls high and low output types and radio input.
- **HIGH FREQUENCY ATTENUATION CONTROL:** Operating on pickups and radio only.
- **PICKUP/RADIO SWITCH:**
- **HIGH FREQUENCY BOOST CONTROL:** Provides 6 to 10 db. boost for microphones.
- **LOW FREQUENCY ATTENUATION CONTROL:** Provides approximately 10 db. attenuation at 50 cycles for feeding horn type speakers.
- **MONITOR ON/OFF SWITCH:**





5 watt portable amplifier, type PA806 provides ample power for the needs of most indoor gatherings and many outdoor applications.

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PA826—30 watt
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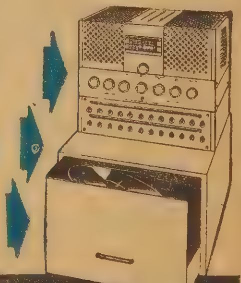

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Electronic Barmaid

THE month's most novel use of electronics comes from Birdham, England, where Alan Tamplin, a retired farmer, invented Nellie.

Nellie is an electronically operated device which rolls out a beer barrel, automatically fills a glass, and rolls it back again.

It is operated by a remote control box which is actually a small transmitter operating on 465 Mc. The barrel mechanism has a small receiver which picks up the impulses from the control box, using the same general system of signals as are employed for the remote control of model boats and aircraft.

The barrel can supply either beer or soft drinks, according to the signal transmitted from the box.

But it takes practice to control the transmitter so that Nellie stops and starts at the right moment.

According to report, the farmer allowed a friend to try his hand with Nellie. He wasn't quick enough on the draw. Nellie's 3½cwt rolled over his foot, fortunately without damage.

From now on Nellie will work only for her master.

* * *

Waiting for TV

ALL has been quiet on the TV front for the past few weeks, and will continue to be so until the Post Master General makes some announcement when Cabinet has considered the recommendations of the Royal Commission on TV.

The Commission's report has been well received in all quarters and it is highly improbable that the Government will disagree on any major matter.

First step will almost certainly be clarification to the ABC of its position, so that it may take action to commence its program.

The hardest part will be consideration of the commercial station angle, the issuing of licences and who will get them.

However, there is no reason to think there has been any change in the general feeling that two years will be the minimum time to elapse before a regular program can be expected.

* * *

VHF in England

MANY eyes will be watching the introduction of VHF broadcasting in England.

As recently announced, the PMG is prepared to grant VHF licences in Australia, but it is most unlikely that any stations will be in a position to do anything about it.

Nevertheless the time will come when their thoughts must turn in that direction, and the experience in England will be of great importance. It is noteworthy that a big BBC program involving many stations is to be implemented at a steady rate —51 in all, nine within two years.

* * *

Costly Binding

There is an old fashioned workshop in the town of High Wycombe, Buckinghamshire, where books are bound in costly leather and tooled just as they were in the Middle Ages. All work is done by hand, yet it is very remunerative. One order was for £7500 worth of copies of Pickwick Papers bound in white pigskin; another for £7000 for a number of copies of Hamlet in fine leather.

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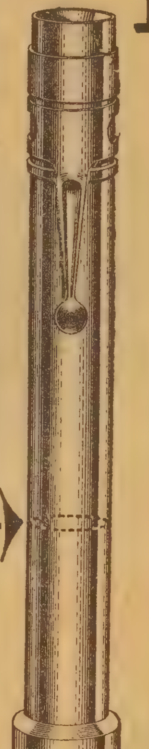

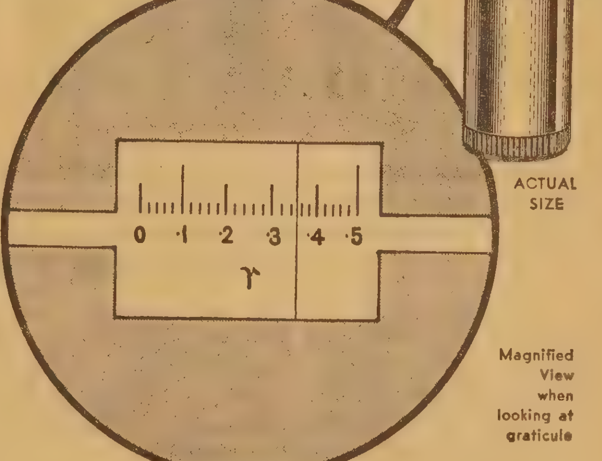

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THE R & H JUNIOR MULTI-METER

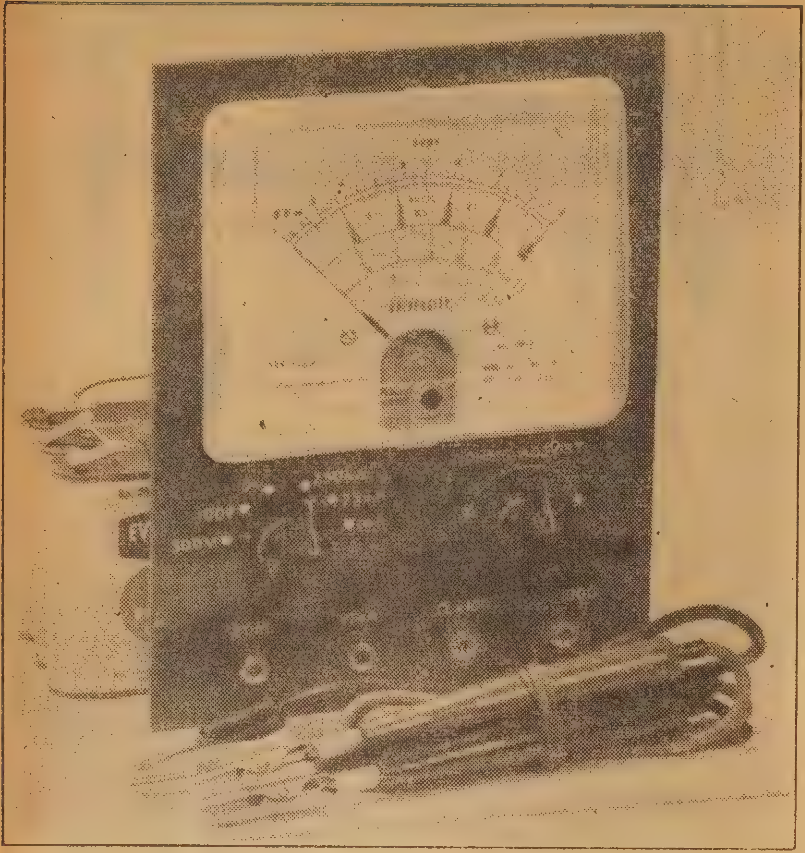
Sooner or later every radio experimenter has need of a multimeter. Most fellows like to make their own, both for the experience and to save money. In this article we describe a simple but effective meter designed to satisfy such a need. Simple and cheap to build, it will still do all you are likely to ask of it.

by Philip Watson

BUILDING radios and amplifiers is great fun while everything runs smoothly and the finished unit works "first time", but the beginner is likely to feel rather helpless when it doesn't work and he has no means of checking any part of it. Since most of the faults in a set will be reflected in abnormal values of voltage, current and resistance, meters to measure these characteristics are the basis of all service equipment.

POPULAR METER

The most popular form of meter for radio work is a multimeter, having a number of ranges and able to function as a voltmeter, milliampmeter and ohmmeter. The idea of combining these functions into one instrument is purely one of economics, it being possible to employ a single meter movement (which is fairly expensive) to perform all these jobs simply by switching it into circuit with various resistors.



The completed meter, ready to be housed in its case. Note the multiple scale on the meter with ohms ranges at the top. Other styles of meters could be used if available provided they conform to the specifications given in the text.

Provided the idea is not carried to clumsy extremes the result is a very convenient instrument.

For radio multimeters the moving coil type meter is used almost exclusively and this is the type we shall consider. Such meters are available in a variety of brands, varying in size from two inches in diameter to five inches, with square and rectangular styles as well as circular.

The type you choose will depend on your personal taste and the amount of money you wish to spend.

In general, the very small types are unsuitable for multimeters, due to the difficulty of accommodating a multiple scale in the small space. A 3in circular type is about the smallest which would be suitable and is quite a popular choice. Next come the 4in rectangular and square types which offer a much larger scale and are very popular. Still larger types would not appear to offer much, except in special cases.

For radio multimeter work the most popular meter is one having a full scale sensitivity of 1 mA and an internal resistance of 100 ohms. The latter value is subject to variation but is now practically standard with Australian manufacturers.

CURRENT TOO HIGH

Lower sensitivity meters are of little use for multimeters, though they may be valuable in special applications where they are confined to one or two ranges. The 5 mA. meters, which have been so readily available through disposals sources, are not suitable as the basis for a multimeter, though they have found plenty of applications in amateur transmitters and similar equipment as multimeters.

The reason is that for full-scale deflection, a current of 5 mA. is needed when reading volts as well as milliamps. This current loading by the meter is too high, and would seriously impair accuracy on all but heavy current circuits.

Any moving coil meter is likely to be affected by mounting it on a steel panel, which by interaction with its magnetic circuit, is sufficient to alter sensitivity by several per cent. Thus it is customary to order a meter according to the panel in which it is to be mounted, i.e., either steel or non-steel. Where steel is specified, the approximate gauge of the panel should also be stated.

A meter for multimeter work should have a multiple scale covering all the likely ranges in volts (both AC and DC), mA. and ohms.

Thus the final specification for our meter would be as follows: Size, to individual choice. 0-1 mA, 100 ohms, multiple scale, for use on non-steel panel.

This assumes, of course, that a new meter is being purchased. If a meter is already on hand, the question naturally arises as to whether it may be used, even if it is not exactly to the above specifications.

METER RESISTANCE

Assuming that it is a 0-1 mA. meter, the matters which are likely to cause concern are the internal resistance and the scale. The internal resistance is not critical if the builder intends to wind his own shunts and has means to check the accuracy of the finished product. We will have more to say on this point later on.

If ready-made shunts are to be used, it is almost certain that the only ones available will be designed for 100 ohm meters. If the meter resistance is unknown, it can usually be determined by the manufacturer and, if it is less than 100 ohms, it is a comparatively simple matter for him to add a "swamp" resistor to bring it up to this value. In fact most meters with a 100 ohm resistance have such a swamp built in.

Don't be tempted to measure the resistance yourself with an ohmmeter, since the amount of current flowing may damage the meter. One method of finding this resistance is to shunt the meter with a variable resistor and adjust it until the meter sensitivity is reduced to half. This external resistance will now equal the meter resistance and can be measured on a bridge or by other suitable means.

SUITABLE SCALES

If the meter is locally made, it is usually possible to obtain a suitable multiple scale from the maker, or have him fit one if you don't feel up to tackling the job yourself.

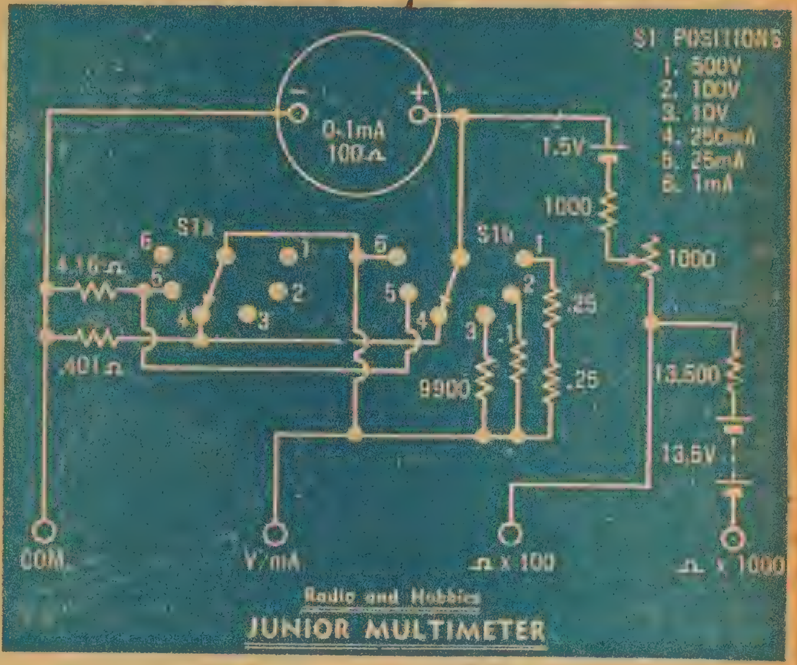
The position is not quite so bright regarding overseas meters salvaged from disposals, though they may have the required sensitivity. Locally-made scales will seldom suit, and it is often difficult to determine their exact characteristics. There is the further complication that they are often difficult to repair in the case of a major defect.

By this we do not mean to infer that you cannot use such a meter if you have one, but we would advise strongly against buying such a meter for the purpose unless its price is low.

So much then for the meter itself. We now come to the circuits which must be used with it, in order to make it into a multimeter.

As we have already intimated, the meter is fundamentally a current reading device which will give a full scale reading when 1 mA (one thousandth part of an amp) is passed through it. All our calculations will be based on this fact, the associated circuitry being arranged to allow this amount of current to flow through the meter at full deflection whether it is being used to measure voltage, current or resistance.

CIRCUIT DIAGRAM OF THE METER



The circuit is quite simple and should be studied in conjunction with the rear photograph and the wiring diagram. Note how the extra battery and resistor are used to give the second ohms range. If the meter resistance is less than 100 ohms it should be made up to this value.

VOLTAGE RANGE

About the simplest example is a voltage range. Because there is a fixed relationship between voltage, current and resistance in any circuit (Ohms law) it is possible for us to determine the voltage applied if we know the current flowing and the resistance of the circuit.

In the case of our 0-1 mA. meter with a resistance of 100 ohms, it is therefore, possible to calculate the voltage which must be applied to the meter in order to force one milliamp through it and so cause it to read full scale. Having done this, we could calibrate the meter as a voltmeter as well as a milliampmeter.

PARTS LIST

1	Meter, size as required, 0-1 mA, 100 ohms, multiple scale, for use on non-steel panel.
1	Black bakelite panel 7⅜in x 5¾in x ⅛in.
1	Switch, single bank, 2 pole, 6 position.
2	.25 meg. 1W 1 pc. carbon resistors.
1	.1 meg. 1W 1 pc. carbon resistor.
1	13,500 ohm 1W 1 pc. carbon resistor.
1	1000 ohm 1W 10 pc carbon resistors.
1	1000 ohm pot.
1	250 mA shunt.
1	25 mA shunt.
4	Tip jack sockets with insulating bushings.
4	¼in metal washers.
	Type H268 double-ended solder lugs.
2	Pointer knobs.
1	8 terminal tag strip (SM28).
3	703 batteries.
1	950 cell.
1	pair of test leads.
	Tinned copper wire, hookup wire, spaghetti sleeving.

According to Ohm's law, it would need 1/10th of a volt to force 1 mA through 100 ohms, so the instrumen would have a full scale reading equal to this value. In actual fact such a scale would not have any great practical use but it serves a the first step in understanding how it is used as a voltmeter.

If the meter coil happened to have a resistance of 1000 ohms instead o 100 ohms (and the sensitivity was still 1 mA) it would obviously need 1 volt to force the required 1 mA through the winding—and give a full scale reading—thus making i a 1 volt meter.

But we don't need actually to change the resistance of the meter coil to change the reading. We can get exactly the same effect by adding resistance in series with it. Thus for a 100 ohm coil we would simply add 900 ohms of resistance in order to bring the total up to 1000. The result would be a 1 volt meter exactly as if we had increased the coi resistance to this value.

Fortunately, there is virtually no limit to the extent to which this idea of range multiplication may be carried and since a 1 volt range is still not a very useful value, we may start thinking in more practica terms.

Assuming we want a 10 volt range we would have to add 9900 ohms to

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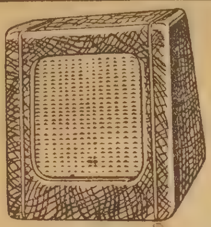

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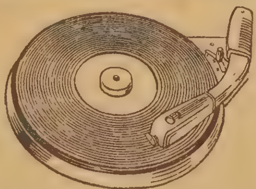

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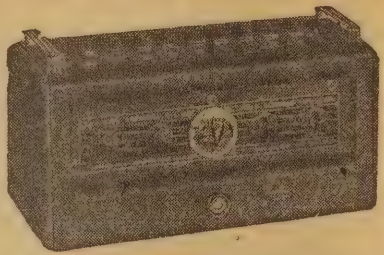

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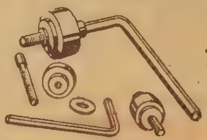

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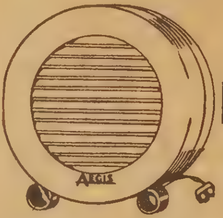

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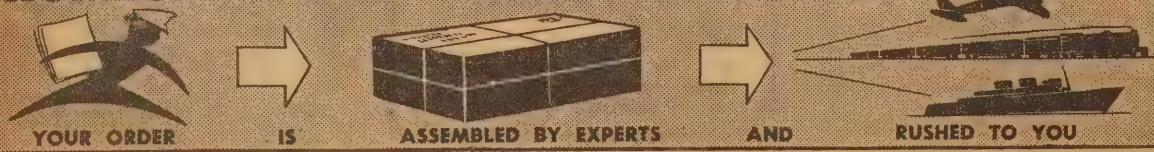
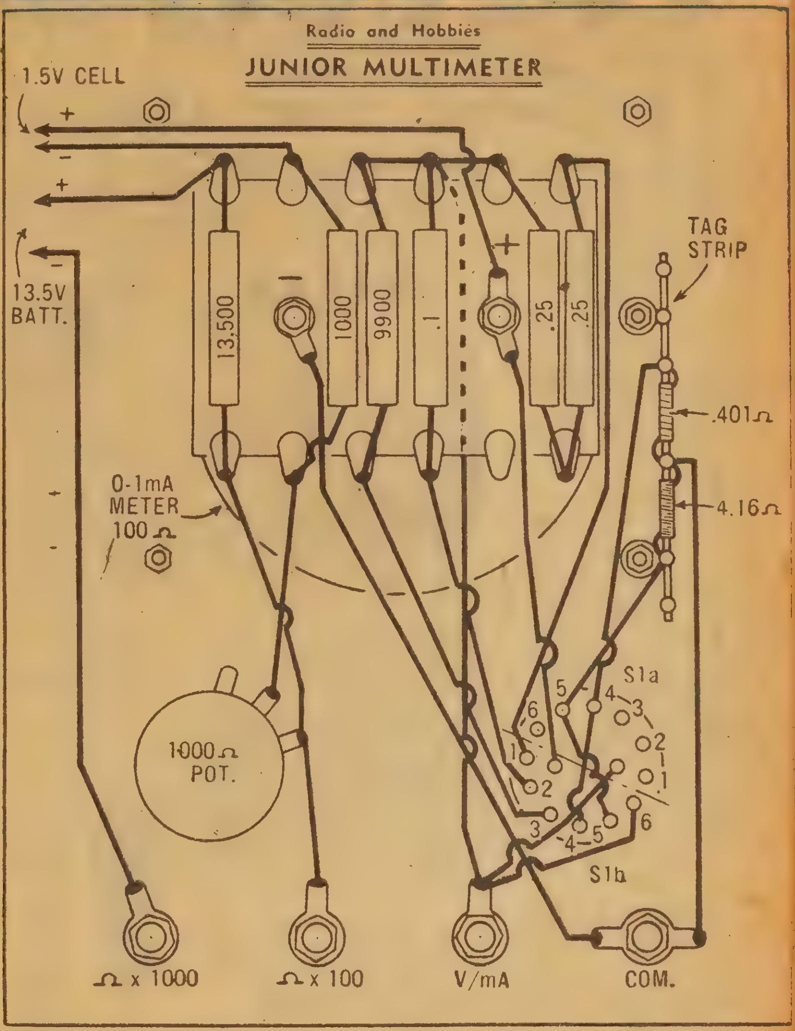


WIRING DIAGRAM OF THE METER



If you are a raw beginner you will be able to wire the meter completely from this diagram. However, it is a good idea to study the circuit diagram as well and to try working from it. With such a simple circuit it should not be hard.

the meter and for a 50 volt range 49,900, or approximately 50,000 ohms.

Note that in the case of low values we take into account the resistance of the meter but, above about 10 volts, the error brought about by neglecting it is so small that we can ignore it.

You will note also that there is a definite relationship between any range and the resistance required to produce it. In this case (using a 0-1 mA meter) it is 1000 ohms for every volt of the full scale deflection.

CURRENT RANGES

The next step is to extend the current range of the meter. The "natural" sensitivity of 0-1 mA is quite a useful one, and it is normal to arrange for it to be one of the ranges of the multimeter. However, currents of up to 250 mA are normally encountered in radio practice and some means must be provided to measure them.

This is achieved by means of resistors called "shunts". They are connected in parallel with the meter and operate on the principle that current will divide and flow through two parallel resistors according to the value of each resistor. Most current will flow through the lower value and, if the shunt is made the lower it will be possible to pass much more than 1 mA through the combination without overloading the meter.

When the meter resistance is known, the value of shunt required to increase the full scale reading by a given factor can be calculated by a simple formula. This states that the meter resistance should be divided by the required factor, minus one. Thus if we wish to increase a 0-1 mA meter to O-10 mA (factor of 10) we divide the 100 ohms by 10 minus 1, or nine. This gives us a value of 11.1 and a 10 mA shunt must have this resistance.

In the same way, the value of resistance for any other value of shunt may be found and, as with the voltage multipliers, there is virtually no limit to the extent to which this idea may be carried. However, it is easy to see that very low values of resistance will be required for the higher ranges. For example a 250 mA shunt will be only .401 ohm, and values of this order are often difficult for the amateur to construct.

OHMS RANGE

Finally, there is the ohms range. This is really an elaboration of a simple continuity meter such as may be made with a battery and torch globe or buzzer.

The difference is that the latter arrangement merely gives an indication of continuity without revealing the amount of resistance involved, while a proper ohmmeter measures the resistance with a reasonable degree of accuracy.

In its simplest form the ohmmeter consists of a battery, a limiting resistor, the meter, and an unknown resistor all connected in series. The value of limiting resistor is so chosen that the battery will force one milliamp through the meter when the unknown resistor is a short circuit. The right hand end of the scale is, therefore, marked "0 ohms", and the meter will read full scale when we short circuit the test prods together.

If the resistor we wish to measure is equal in value to the limiting resistor, 0.5 mA will flow and the meter will read half scale. We may thus calibrate this point as indicating the value of the limiting resistor. Other points on the scale may be calculated similarly, but there is no need to elaborate because suitable markings will be par of any multimeter scale.

WIRE RESISTANCE TABLE

SWG gauge	Ohms/ft
39	.376
40	.442
41	.526
B & S gauge	
35	.329
36	.4148
37	.5321

Since a single resistance range i not usually sufficient for radio worl at least two ranges are fitted to mos instruments, while many have fou and a few larger types have a many as five. Extending the range to measure higher values of resistance is achieved simply by increasing values of battery voltage an limiting resistor in proportior Ranges to measure lower values tha are possible with a single cell ar achieved by shunting the meter an the limiting resistor.

The highest resistance range tha can be provided is determined b the highest voltage battery that ca be accommodated conveniently. Th lowest range is limited by th amount of current which the battery can deliver. In practice, a 15 volt battery is regarded as abou the largest practical size and 10 mA about the highest value tha needs to be taken from a batter on the low ranges.

So much, then, for our brie "thumbnail sketch" of a multimetei

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Unit viewed from above with turntable removed.

- MOTOR, A.C., 200-250v, 50 cycles.
- AUTOMATIC STOP AND START, Independent of record size or length of playing surface. Operated by run-off groove.
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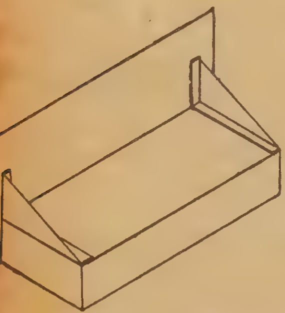

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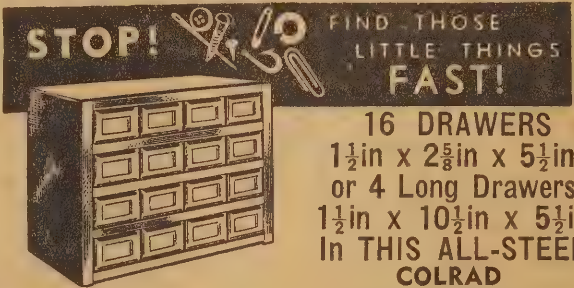
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Now let us consider a practical version in sufficient detail to enable a beginner to make his own.

In setting out to design this meter we wanted something which would serve the beginner in all aspects of his radio work for some time to come, and at the same time not cost him any more than absolutely necessary. The final result should make it possible for many beginners to own a multimeter and cope with most of their own service problems.

We devoted much time to devising ways and means of reducing cost without seriously affecting the performance of the finished meter. One suggestion is that the builder make his own wooden case or box since a ready-made version is often an expensive item. You will save a couple of pounds on this alone.

Another suggestion is that he winds his own shunts. This is not always an easy job, but it will save quite a few shillings and is worthwhile, even as a temporary measure.

Next we considered what ranges could reasonably be eliminated, remembering that a beginner's requirements are not as exacting as those of a professional serviceman. The first thing to go was the AC range. These are handy, but not essential, and with rectifier and switch, can add something like £2 to the cost of the instrument.

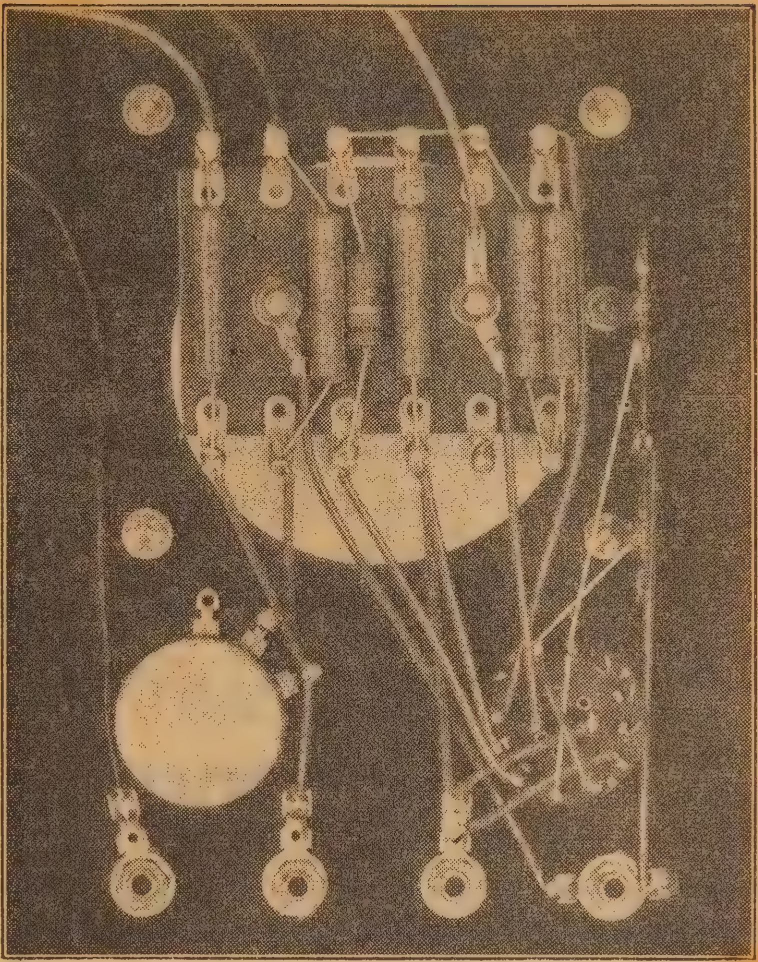
SWITCH USED

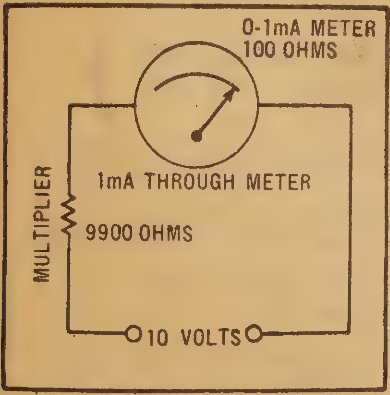
In the DC section we finally selected three voltage ranges, three current ranges, and two ohms ranges. This combination enabled us to use a simple, inexpensive switch, as well as reducing the shunts and multipliers. The ranges selected will cope with all the voltages, currents, and resistors encountered in a battery or AC set.

We deliberately avoided schemes involving tip jacks. Those require multiple shunts and the home constructor cannot satisfactorily make these himself.

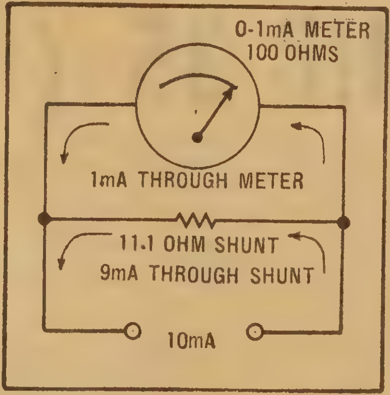
For the ohms ranges we finally settled for the two higher ranges normally fitted to more elaborate meters. These provide coverage from 25 ohms at the lowest reading to one megohm at the highest, and cover all but the most unusual requirements. We deliberately avoided the lower ranges which would involve the use of either multiple tip jacks or a more complex switch.

In its final form the meter has the following ranges: 500V, 100V, 10V, 250mA, 25mA, 1mA, ohms (scale) X 100 and ohms X 1000. The voltage and current ranges are selected by means of the switch and the ohms ranges by means of two extra tip jack sockets. The switch is normally set

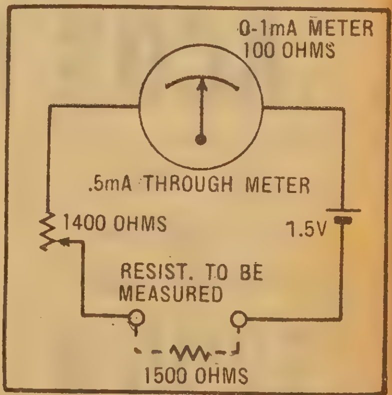

This rear view of the meter gives an excellent idea of the physical layout. On the left of the resistor panel is the 13,500 ohm resistor, followed by the 1000, 9900, .1meg., and the two .25 meg. resistors in that order. The shunts are wound on the tag strip at the right.



The elementary circuit of the voltmeter. The multiplier value is chosen to allow only one milliamp to flow through the meter when 10 volts is applied. The scale is calibrated as a 0-10 voltmeter.



The principle of extending the current range of a meter. Here a total of 10 mA flows through the circuit but only 1 mA through the meter, the remaining 9 mA through the shunt. The scale meter is calibrated as a 0-10 milliampmeter.



How the ohmmeter works. The meter indicates the amount of current the external resistor allows to pass, but is calibrated in ohms. The internal variable resistor limits the maximum current to 1 mA under short circuit conditions.

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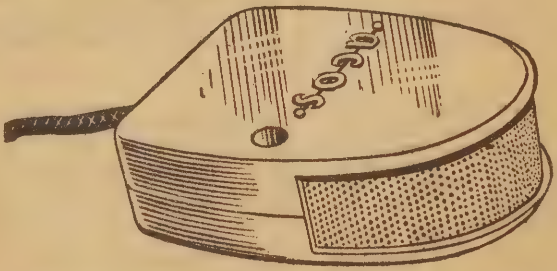

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Approximate capacitance of the microphone is 750pF and cable capacitance will reduce output proportionately.

Frequency response	Substantially flat from 50/5,000 cps.
Output level	— 55 db ref. 1 volt/dyne/cm2.
Load resistance	2 megohms included.
Cable	This microphone is supplied with approximately 4ft. 1.2 metres of co-axial cable (type Unirad 32).
Weight	Microphone only — 6oz. (approx. 170 grammes) complete with packing 7oz. (approx. 198 grammes).
Dimensions	Microphone only 2 7/8in x 2 1/8in x 7/8in plus cable. Complete with packing 3 3/8in x 2½in x 2¼in.

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to the 0-1 mA position when reading ohms.

Next is the all important question of the shunts and whether they are to be bought or made. Most of the cost in a ready-made shunt is labor cost and it is therefore possible to save a worthwhile amount if these can be made. There are several methods which may be used and a survey of them should help the beginner.

BY CALCULATION

The first method is to calculate the values of resistance required by the formula already given and make up resistors of these values using resistance wire and an accurate resistance measuring bridge. Not many will have access to such equipment but, for those who have, it is a fairly straightforward process.

The second method is to calculate, from wire tables, the length of wire required in a given gauge and material to produce the required resistance.

At first glance this may appear to risk introducing a large number of possible variables which could cause serious errors. Against this we can only point out that we tried the idea and produced shunts which were within four or five pc of the required value. While not quite as good as a commercial shunt, they would be quite good enough for a start.

The main worry is to be sure that the gauge and material of the wire is positively known, since the difference between the various resistance wires is considerable, as also is the difference between adjacent gauges or between the same gauges in two different systems.

However, the most promising scheme, and the one we used, is to use copper wire rather than resistance wire. If a suitable gauge is chosen, the lengths involved are not great and copper wire is usually easier to come by than resistance wire. It also has the advantage on minimising errors due to temperature change, the temperature coefficient of the shunt and the meter coil being the same, both being of copper.

In a panel elsewhere in the article you will find data for copper wire in the recommended gauges and from which you can calculate the correct length. The shunt values are: 25 mA, 4.16 ohms; 250 mA, .401 ohms.

The third method is to use the meter itself as a standard and to adjust the shunt until the meter reading is reduced by the required factor. For example: if it is desired to wind a 25 mA shunt the meter is first connected in a circuit consisting of a battery and variable resistor with the latter adjusted to allow the meter to read full scale, representing one milliamp. The shunt is now adjusted until the meter reads 1/25 of the scale, thus giving the required multiplication.

The main causes of error in this system are the difficulty of making an accurate reading with only a small scale deflection, the presence of some non-linearity in every meter, and a change in current flow due to the change of persistence in the circuit when the shunt is connected.

There is not much that can be done about the first two except to take more than usual care with the readings and to check carefully for correct zero setting before commencing. The error due to changed battery load can be minimised by making the total resistance in the circuit as high as possible so that the change relative to the total is small. This is done by using the highest convenient battery voltage with an appropriate value of limiting resistor.

It would appear that 6 volts is about the minimum to ensure reasonable accuracy, though twice this value would be better. The error using only two volts was considerable.

OVERLOAD RISK

When shunting from 1mA to 25mA there is little danger of overloading the meter, but from 25mA to 250mA it can be risky. First set the variable resistor to pass 25mA through the shunted meter. Then open the circuit and remove the 25mA shunt.

Now connect the trial length of wire for the 250mA shunt, making sure that it cannot become disconnected. If it should you would severely overload the meter. The circuit may now be closed and the reading checked.

Using this system we were able to produce shunts with an accuracy similar to those which we calculated from the wire tables. Just to be different we wound these with resistance wire from a jug replacement element costing sixpence. It contained enough wire for several shunts.

Particularly when using resistance wire, it is important to guard against false readings due to currents generated when the junction of two dissimilar metals is heated. This can happen when resistance wire is soldered to a copper lug. It can even make the meter read backward temporarily, and an accurate reading is not possible until the junction has cooled. It may be cooled quickly by means of a cloth soaked in metylated spirit.

EXTRA METER CHECK

The fourth method of making shunts is to connect your meter in series with another meter having suitable ranges and use this as a standard against which the shunts can be adjusted. It is a good method if you can find someone game to lend you his precious meter while you fiddle around with shunts, though the risk to your meter is probably greater than to his. This method is often most useful after one of the other systems has been used to bring the shunts to their approximate values.

A disadvantage of bare resistance wire is that because adjacent turns may short circuit, it is difficult to wind into a permanent form except where very short lengths are involved. Our final choice was 40 SWG enamelled copper wire, a length of 113in being used for the 25mA shunt and 10.9in for the 250mA shunt.

A satisfactory "former" was simply made by removing two terminals from a standard eight terminal tag strip (type SM28). The terminal each side of the centre is removed by drilling out the rivet, and the wire wound in the space so provided. The lugs on each side provide terminations for the wire, and the longer piece may be simply bunch wound to fit it in the space.

The multipliers for the voltage ranges are 1 watt carbon type resistors and should have an accuracy

(Continued on Page 103)

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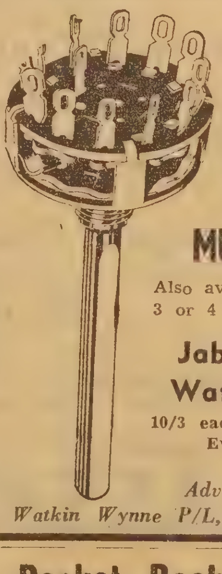

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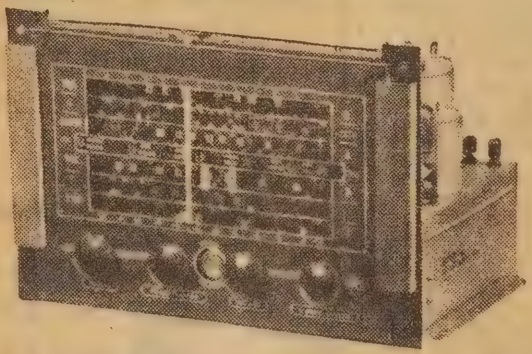

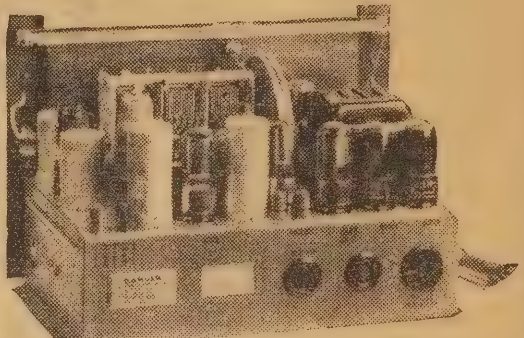

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A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

AN ELECTRONIC ALARM TO SAFEGUARD DISPLAY GOODS

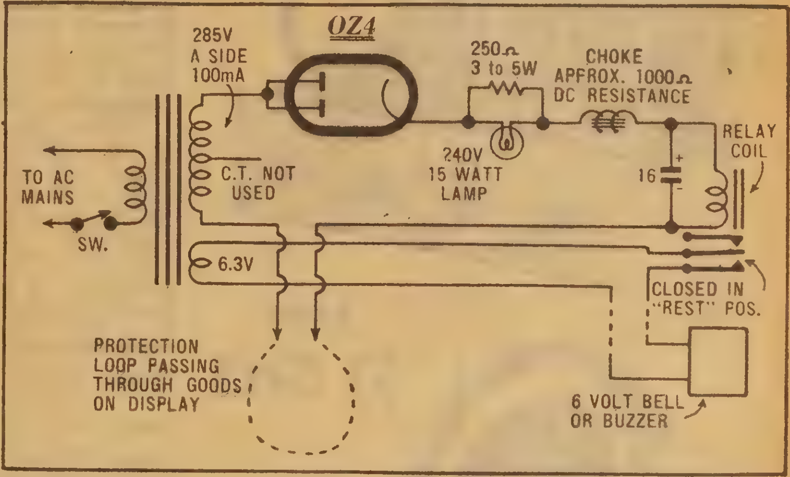
This month we are digressing from the usual run of radio sets, amplifiers, test equipment and suchlike to present a couple of unusual electrical gadgets which may prove of use to some of our readers.

THE first idea has been submitted by Mr. E. C. Watkins, of 67 Brittannia St., Christchurch, New Zealand. It is an electronic alarm system designed initially to protect displayed goods from theft but which can be adapted easily for other jobs.

Although there are easier ways of achieving the object using a battery source, as illustrated in the October, 1953, issue of Radio and Hobbies, this unit operates completely from the power mains and can be made up from components usually found in a home constructor's workshop.

The transformer used appears to be of 285 volts a side and rated at 100 mA. This is half-wave rectified by OZ4, a gaseous type rectifier, and a current of 100 mA to 150 mA passed around the series circuit, causing the relay to close its unused contacts.

The protection loop is passed through the articles to be guarded and joined at a convenient point.



If the protection loop is broken, the relay coil excitation is interrupted and the contacts go to their "rest" position and close the bell circuit to give the alarm.

The current quoted exceeds the 75 mA rating of the OZ4 and it would be wise to use a more sensitive relay and adjust the amount of resistance in circuit to restrict the current to around this figure.

On the other hand, most of the high vacuum type of rectifiers have a higher current rating but their high internal impedance will result in a lower output voltage. It simply means, however, that the series resistance in the circuit should be adjusted to suit the relay requirements within the rating of the rectifier used.

The lamp serves as a check on the system. If it is not alight, when the system is on, the bell should be ringing. A .15 ampere dial lamp could be used, without the series resistor, but, in this case, only one half of the transformer secondary should be used.

* * *

A RELAY-OPERATED BIRD TRAP

Here is a refinement to the traditional string or stick trip in the usual bird-trapping cage. The weight of the small bird on the bait platform closes an electrical circuit to operate a relay which allows a sliding door to drop. The idea is submitted by A. D. Patch of 44 Waratah St., Haberfield, NSW.

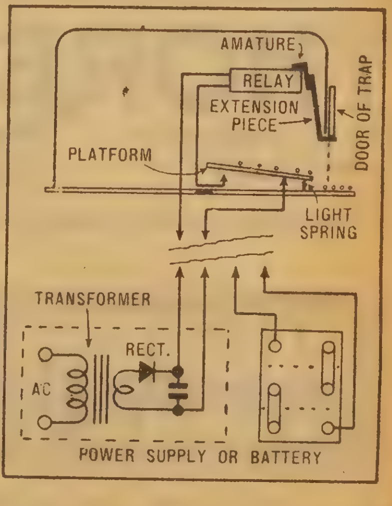
THE relay is of the conventional type suitable for the available voltage supply. An old but serviceable automobile cut-out could be pressed into service. The important point is that it should have a positive action when operated from, say, an accumulator.

Sweat an extension piece to the armature as illustrated and bend up the free end to hold the door open. Remove the burr from this end and lubricate it and the door to give as free a releasing movement as possible.

You will need to strike a compromise between the length of the armature extension, and, consequently, the amount of movement of the end supporting the door, and the ability of the relay to pull in the armature.

The platform may be made up out of sheet metal or a piece of 3-ply carrying a metal strip on the underside to close the circuit when required. The platform is pivoted on a knife-edge and spring-loaded at the end near the door. The resistance of the spring should be just sufficient to hold the platform circuit open.

The contact under the inside end of the platform could simply be a nail driven up through the bottom of the cage. Needless to say, the condition of this contact should be checked each time the case is to be used.



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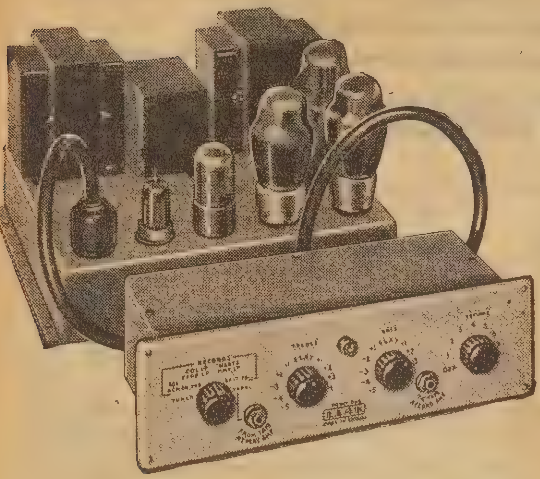
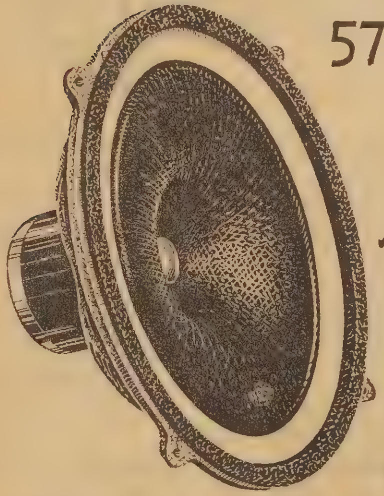


Specifications:

Circuitry: A triple loop feedback circuit based on the famous TL/12. The output transformer is the same size as in the TL/12.
Maximum Power output: 10 watts.
Frequency Response: plus/minus 1 db 20 c/s to 20,000 c/s.
Harmonic Distortion: 0.1 pc, 1,000 c/s 7.5 watts output.
Feedback Magnitude: 26db main loop.
Damping Factor: 25.
Hum: 80 db referred to 10 watts.
Loudspeaker Impedances: 16 ohms, 8 ohms and 4 ohms.

Pickup: The Pre-Amplifier will operate from any pickup generally available in the world. A continuously variable input attenuator at the rear of the pre-amplifier permits the instantaneous use of crystal, moving-iron and moving-coil pickups.
Radio: The radio input sockets at the rear permit the connection of any tuner unit. An input attenuator is fitted. H.T. and filament supplies are available from the pre-amplifier.
Distortion: Of the order of 0.1 pc.
Hum: Negligible due to the use of recently developed valves and special techniques.
Input Selector: Radio, Tape, Records, any and all records can be accurately equalised.
Treble: Continuously variable, plus 9 db to —15db at 10,000 c/s.
Bass: Continuously variable, plus 12 db to —13 db at 40 c/s.
Volume Control and Switch: The switch controls the power supply to the TL/10 power amplifier.
Tape Recording Jacks: An exclusive feature. Readily accessible jacks are provided on the front panel for instantaneous use.

PRICE
57 GNS



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FROM THE SERVICEMAN WHO TELLS

Just to show that a serviceman's life is not one continuous round of obscure and difficult faults, I have included two cases this month which were handled in a matter of minutes. There is also some more comment on damaged speaker cones and an unusual portable receiver fault.

BEFORE delving into my own technical problems this month I would like to acknowledge a letter from a reader, R.F.A., of Newstead, Victoria. It appears that this letter was prompted by my reference in the July issue to the near tragedy to my own high quality speaker when a visiting child poked his finger in the hemispherical high frequency radiator in the centre of the cone assembly.

Apparently all small children are built to a fairly standard pattern, because this correspondent has had a similar experience, and not once, but twice! With reference to the second experience he writes:

YOUNG CURIOSITY

"Unfortunately the same thing happened again (apparently these radiators offer some fascination for the younger generation); this time all my efforts were in vain and I was resigning myself to the loss of the precious highs.

"When I returned from work, however, there was the cone restored to its former splendor; wife had rushed in where angels . . . &c., and applied the vacuum cleaner hose to the radiator, with completely successful results."

"I wonder how many other of these speakers have met with the same trouble?"

Well, thanks, R.F.A., and the solution is a very interesting one. As a matter of fact, the same idea did occur to me in the few seconds of mental groping when the tragedy occurred, but I felt that the idea was a trifle drastic and only to be used if all else failed. Apparently I need not have been so cautious.

Another idea which crossed my mind at the same time was, that a heavy 50-cycle signal applied to the voice coil might do the trick if the amplitude was great enough (within reason, of course) and a quantity of air could be trapped in the space behind the dented radiator. I've not had a chance to try it, but it might be an idea if all else fails.

HIGH CASUALTIES

Regarding R.F.A.'s query about how many other speakers have suffered a similar fate I rather gather that the casualty rate is fairly high. I have heard of a couple of enthusiasts who have had similar troubles and also of a near riot, which was caused in one of our wholesale houses during a recent stocktaking period.

The speaker in this case was one having an aluminium foil radiator and was priced in the vicinity of £25. Imagine the consternation, therefore, when careless handling on someone's part resulted in a dented radiator. The departmental head wailed and gnashed his teeth, threatened to sack everybody on the spot, then took the speaker into the technical section to seek their aid.

The technical staff stood around the speaker in a solemn group. Various suggestions were made, mostly along the lines of whether the speaker could be dismantled, and, if so, how. At the same time nobody was keen to tackle the job and things had just about reached a deadlock when the group was joined by an essentially non-technical member of the staff in the person of the office typist.

In answer to her question, someone rather patronisingly explained the problem, adopting an attitude of "Don't you worry your pretty little head about it, my dear." Whereupon she completely deflated everybody's ego by making the obvious suggestion, "Why not use a piece of sticky tape?"

And, of course, it worked!

Coming closer home, I had two cases this month which suggested that I might perhaps create the wrong impression by reason of the cases I describe. If my stories paint a picture of a harassed serviceman, who never does anything but cure apparently incurable faults, chase elusive intermittents, or unearth faults which have never been heard of before, then it is not a true picture.

EXCEPTIONAL CASES

It is true, of course, that these things happen, not only to me, but to other servicemen, a fact which is supported by letters I receive from readers. But it is equally true that these cases are the exception and only represent a small percentage of the total number passing through a typical service department. They are selected, fairly obviously, because they are unusual and, therefore, interesting and instructive.

However, interesting and instructive though they may be in retrospect, they seldom help the finances very markedly, and it is the routine jobs which usually have to carry the sticky ones. For this reason, it is the set which can be disposed of—effectively—in short order, which your serviceman likes to see, even if it does mean scratching the head for an article at the end of the month.

Which brings me to the two cases which I consider excellent examples of how quickly some jobs can be handled when fate is on your side.

The first was a typical four valve mantel set, which the owner pushed across the counter with the cryptic announcement that, "It hums." One has to refrain from facetious remarks in business, so I simply asked for some more details.

At first the suggestion was that the hum was intermittent, but a little more probing narrowed it down to being noticed only when the set was tuned to a station.

"That's what we call modulation hum," I explained.

"Well, I don't know what you call it, but it's darned annoying," was the reply.

Things being a trifle slack at the particular time, I suggested that I check the set right away, and the owner was quite happy to wait a few minutes while I did so. Sure enough, as soon as the set warmed up, it showed evidence of the modulation hum. I also noticed that the hum was most pronounced when I was touching the bare control shafts or the chassis, the whole thing being extremely "touchy" in this respect.

I quizzed the owner about the conditions under which the set normally operated, particularly the aerial and earth arrangements. It appeared that the aerial was a fairly conventional indoor type and an earth was normally used.

HUM PICKUP

At the moment the set had about four feet of aerial wire attached and this was drooped over the edge of the bench alongside the power cord. I picked it up and moved it away at right angles to the power cord, whereupon the hum vanished completely and all sign of the previous touchiness vanished.

I asked the owner if by any chance the aerial lead ran close to the power cord in his normal home installation. It appeared that it did, the power cord and the aerial lead normally being tacked side by side down the wall to the skirting board, where the power cord ran to the power point and the aerial by devious paths to the picture rail.

And that seemed to be the answer to the problem. The aerial was normally picking up considerable signal from the power mains, these signals having been well and truly modulated at 50 cycles. Curing the modulation hum was simply a matter of altering the aerial lead run.

The customer, being thus advised, tucked the set under his arm and departed (having first paid me my consultation fee, of course), quite happy that his problem had been so quickly and definitely solved. For my part, I was quite happy, too, because the entire process had taken only a few minutes, and I had been able to make a reasonable charge and still had a satisfied customer.

PORTABLE PROBLEM

The second case was not quite so easy, but can still be regarded as a lucky break, which made possible a quick job. The set was a personal portable of the ultra midget variety and the owner complained that "—it just went dead."

I received something of a shock when I opened the case. The set was not built on a chassis as such,

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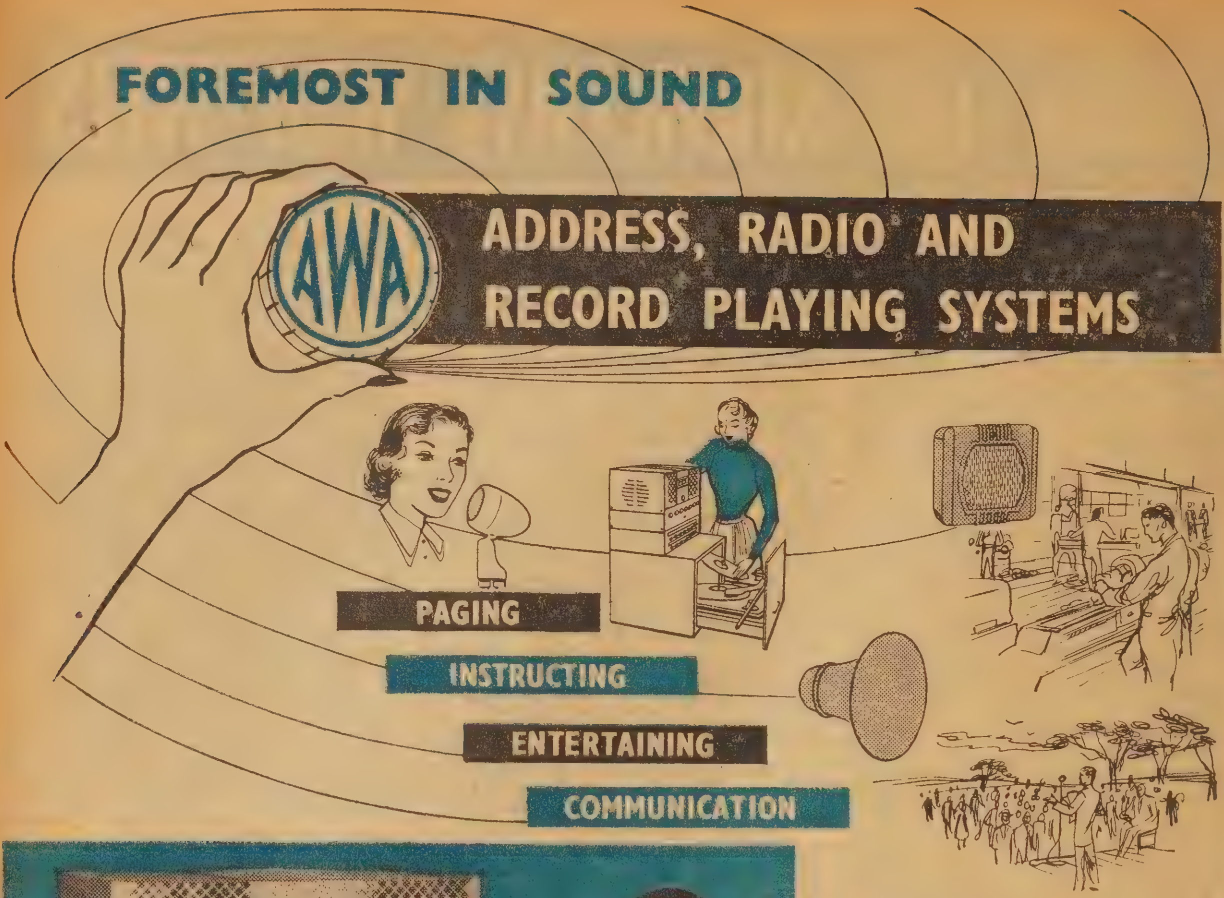

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but rather on a series of small brackets mounted at all kinds of odd angles. To quote a confrere with a passion for pithy sayings, it was "all over the place like a mad dog's breakfast".

In addition, the parts were so packed in that it was almost impossible to see what went where. It was not even possible to see which valve was which without taking them from their sockets, and the underside of the sockets were so overgrown with components that it was, in most cases, impossible to identify the socket pins.

Since I had never seen this particular model before and had no circuit, I didn't relish the idea of delving into its innards. The best that I could hope for was that the circuit was reasonably standard without any fancy curly-cum-back ideas just to make it harder.

However, there was no point in meeting trouble half-way so I connected the batteries and made a quick test with a moist finger on the hot end of the volume control. A buzz from the speaker suggested that all was well with the audio end and having identified the two audio valves, I turned to the front end.

VOLTAGE CHECK

A voltage check on the IF valve was possible only in the vaguest kind of way because it was impossible to tell which pin was which. I contented myself with making a measurement from each to chassis and having found two side by side which measured 67.5 I reasoned that plate and screen voltages were intact. I also found one pin that produced a click in the output. I reasoned that this was the grid and that the set thus far was operative.

Next I tackled the converter, the pins of which were similarly obscured. I could only find one pin which gave any HT reading, whereas there should have been two; plate and screen, the latter also serving as oscillator anode.

I didn't know whether the voltage I did find was plate or screen, meaning that I didn't know whether to suspect the IF transformer or the oscillator coil. Since the oscillator coil was by far the easiest to get at, I tried it first. It was an unshielded bobbin with four small lugs riveted to the former and I checked each of these for HT voltage. I found it on only one, which immediately suggested an open winding.

More careful visual examination soon revealed the reason. One wire from a lug had been stretched too tightly and a change in temperature or some vibration had finished the job. I proved the point by placing the blade of a screwdriver between the broken ends of the wire, which immediately brought forth sweet music.

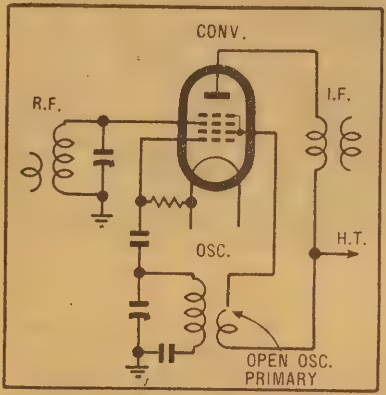
PERMANENT REPAIR

Effecting a permanent repair was not as difficult as it might have been, either. The lug to which the wire had to be connected was one of the few points that was reasonably in the clear and it needed only a few minutes' work to clean the broken end, extend the lead and resolder it to the lug. After that the set performed as well as ever.

The important point about this job was that it took not much longer than it takes to tell the story, partly because it was a straight-out dead set and partly because fate was on my side. At any other time the same set would have had a dry joint in an obscure connection which would have taken hours to track down.

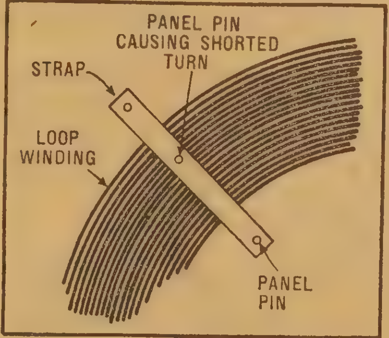
My next case reverts to the unusual type. It was another portable; a home-made one this time. The complaint was an intermittent drop in volume at odd intervals. The set was apparently an excellent performer when working properly and had given many months of satisfactory service until now, but it was virtually worthless when it took one of its temperamental turns.

It needed only a brief run on the bench to confirm the owners' report and I imagined that I should not have much trouble finding an intermittent which occurred as frequently as this one apparently did.



An open circuit primary winding of the oscillator coil caused a failure in this set.

But out of the cabinet and on the bench the set played normally and nothing I could do would coax it to fail. I poked at the wiring and joints, pounded the chassis, tapped condensers and valves and, in short, did everything I could to make it fail. Nothing doing; the set played stubbornly on in the most infuriating manner.



A panel pin shorted a turn on this loop aerial and ruined performance.

While it was playing, I connected the generator and checked the IF alignment and sensitivity, followed by a similar check on the aerial and RF stages. None was more than a fraction out of alignment and the sensitivity quite good. I made a note of the performance figures in case they might be useful when the fault did show up.

The only positive action I was able to take was to replace two AVC by-pass capacitors which were of a brand and type which I knew had given a lot of intermittent trouble in the past.

After several more hours' running on the bench with no sign of trouble I was beginning to think that it might have been in one of the capacitors I had replaced. Anyway I decided to return the set to the owner for a trial period and accordingly fitted the set back in its cabinet.

I tuned in a weak out-of-town station which I find a handy performance guide and proceeded to peak the aerial trimmer with the loop fitted in place. In the middle of the job the signals vanished and, what was more, I was unable to find any peak in the aerial trimmer when a stronger station was tuned in.

Then the set came good again and I was able to peak the trimmer in a perfectly normal manner. Leaving the set running, I unscrewed the back of the cabinet, noting as I did so, that flexing the back seemed to control the fault. Since the loop was wound flat against the inside of this back I was strongly suspicious of it, particularly in view of the aerial trimmer failure.

SUSPECT LOOP

There were no obvious faults, such as dry joints to the loop terminals, but I noticed something in the method of mounting which looked suspicious. The loop was made from plastic-covered bell wire and was held flat against the cabinet back by means of four wooden strips fastened to the back with panel pins.

What caught my eye was that one of the panel pins had been driven between the turns of the loop. It took only a few moments to withdraw the doubtful pin and the fault immediately disappeared. More careful examination confirmed what I had suspected; the pin had cut or worn through the insulation of adjacent turns, thus producing a very effectively shorted turn.

Naturally no loop can perform correctly under such conditions, since the losses in the shorted turn would absorb most of the energy it originally collected. The reason the fault only showed up when the back was fitted to the cabinet was apparently due to a certain amount of distortion caused to the back when the screws were tightened. It was only under these conditions that the nail could touch both turns of the loop.

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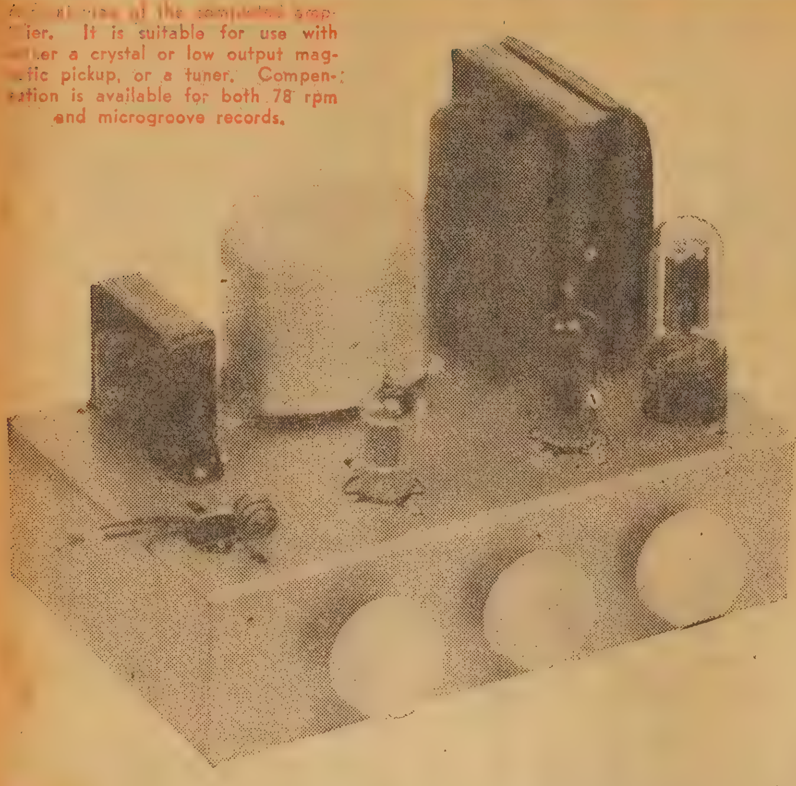
by Philip Watson



[illegible] view of the completed amplifier. It is suitable for use with either a crystal or low output magnetic pickup, or a tuner. Compensation is available for both 78 rpm and microgroove records.

The controls from left to right are: compensation switch, volume and variable top cut. The length of shielded lead is the input for magnetic pickups and the unshielded lead for crystal pickup or radio tuner.

AS we intimated in the August issue we are at present trying to cater for those readers who, while keen on good quality reproduction, must count their pennies with rather more care than their more fortunate fellows for whom ". . . only the best is good enough".

Thus it was that we produced the "Standard Amplifier No. 1", described in the August issue, and suggested various ways in which the cost could be lowered without too seriously effecting the performance. Now we present the "Standard Amplifier No. 2" in the hope that it will serve a similar purpose for those readers who do not need a large amplifier.

SINGLE-ENDED

Our first and natural reaction was simply to produce a single-ended equivalent to last month's amplifier, assuming that it would be used with the same, simplified control unit.

However, it soon became obvious that such an amplifier would hardly differ at all from the "Playmaster Junior" which, after all, isn't a very elaborate affair. There would be little more to it than might be summed up in the sentence "Build the Playmaster Junior but cut down on the specifications of the output transformer and power equipment".

With this thought in mind, we turned to the alternative approach of describing a single unit amplifier, which would have enough overall gain and sufficient control facilities to obviate altogether the need for a special control unit. You may remember that we followed this procedure with both the "Unit Playmaster" and the "Baby Playmaster".

As a result, the circuit is fashioned along the same general lines as the original Playmaster Baby, featured in the December, 1951, issue. However, the circuit has been modified somewhat in accordance with the present day components and requirements. We have used higher gain valves than the original and selected compensation curves more in keeping with the current trend.

FLEXIBLE INPUT

Thus the circuit provides an input channel with enough gain for magnetic or heavily compensated crystal pickups and with alternative compensation for 78 and microgroove recordings. A second input channel is suitable for use with a radio tuner or an uncompensated crystal pickup, a tone control allowing the treble response to be further varied, as required.

Reviewing the circuit, the output valve is a high gain 6BV7 and this is driven by a 12AX7, a high-gain twin triode.

One triode section alone provides enough gain to permit using with a crystal pickup or tuner, while the second section provides the additional gain necessary for use with a compensating divider for magnetic pickups.

In order to avoid the use of an expensive and complicated switch, we selected two degrees of compensation, one for 78 rpm discs and one for microgroove. Although something of a compromise we think most users will find the arrangement adequate, particularly as the circuit provides a very effective variable top cut control, quite separate from the compensation network.

On the basis that most 78 rpm discs are recorded with the bass cut but no treble boost, the compensation for these provides bass boost with a level top response. For the few records which have some treble pre-emphasis the variable top cut filter will serve to level things off.

BASS BOOST

The bass boost characteristic in this position follows closely to the "EMI-European" characteristic (Radio and Hobbies, June, 1954) and should suit the great majority of 78 rpm records.

In the extreme case of recordings made to the more severe curves, the obvious course is to play them with the switch in the "microgroove" position.

In the microgroove position the compensation curve follows very closely to a combination of the AES treble and RCA's "New Ortho" bass. We selected this for a number of reasons, the chief one being that it calls for least treble cut, thus making it possible to compensate for other treble characteristics by means of the variable top cut filter.

Another major reason is that most of the recording companies appear to be drifting toward a compensation curve of this shape or, at any rate, something very close to it.

A third position on the switch selects an input suitable for a crystal pickup or tuner. No fixed compensation is used but the variable top cut filter is still operative. It is sufficiently effective to provide the necessary top cut for microgroove records played with a crystal pickup, while the natural bass boost of these picks will take care of lower frequencies.

4-WATT OUTPUT

If you have a crystal pickup and can compensate it so that it behaves like a magnetic, so much the better. It can be fed into the low level input and treated to the same two degrees of compensation.

The amplifier has a nominal power output of 4 watts, which is adequate for domestic listening, and a quality which would be only slightly less than its Playmaster counterpart.

A major saving in cost may be achieved by the use of a moderately priced speaker transformer. We don't recommend the small variety such as is found on the ordinary eight or ten inch speaker — that would be pushing things too far—but we do suggest one of the larger types which are now available with the better quality speakers in the various local brands. These may not be as good as the type costing several pounds but they are still better than average and are quite moderately priced.

If your finances can stretch to one of the 6-watt wide-range types available for single-ended amplifiers, so much the better. We are not counting on this, however.

In anticipation of such a transformer being used we modified the feedback circuit to exclude the transformer. This is to avoid possible complications due to phase rotation at the extreme low or extreme high frequency end of the band, with consequent positive feedback and oscillation at these frequencies.

FEEDBACK

We don't say that "voice coil" feedback is impossible, but it is wiser to play safe when the transformer is an unknown quantity.

As it is, the feedback network connects from the plate of the output valve to the plate of the second driver stage providing, at the same time, a very effective variable top cut filter. In operation the small capacitor across the potentiometer increases the feedback at the higher frequencies and thus reduces the gain. The degree of top cut is governed by the portion of the potentiometer across which the capacitor is connected.

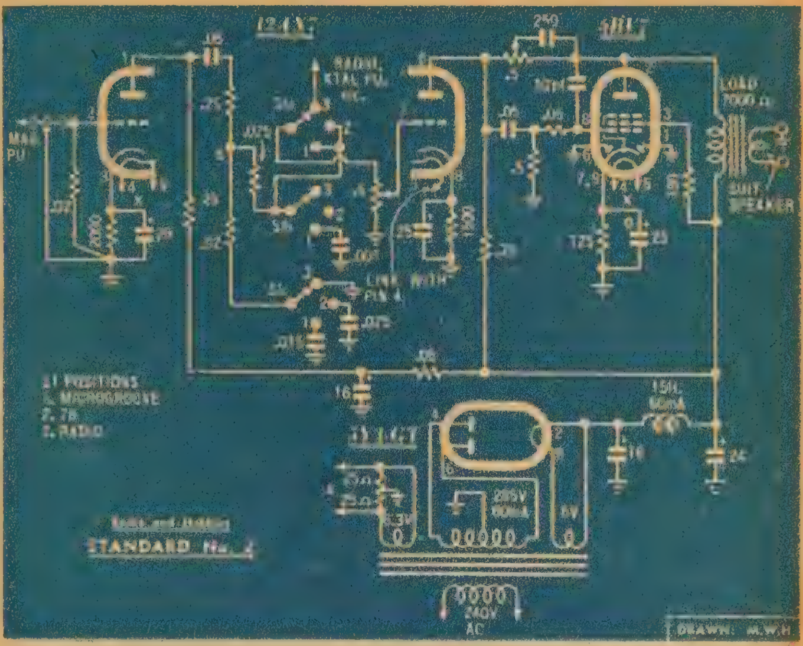
A further saving in cost may be made by using one of the smaller filter chokes rated at 15 henries, 60 mA. The one we used measured approximately 2in high and 2¼in wide. Although theoretically less efficient than the larger types we found it quite adequate when used with fairly liberal values of capacitance and there would seem to be little point in using a larger type.

This does not mean that liberties may be taken in the matter of hum, because any high gain amplifier is likely to give trouble in this regard unless proper precautions are taken. However, most of the problems are concerned with 50 cycle induced hum rather than 100 cycle filter ripple.

It must be realised that, as far as hum is concerned, we are interested in the gain of the amplifier at 50 or 100 cycles and this will be many times greater than at 1000 cycles, due to the bass boost circuit.

A most important point is to return all the earth connections associated with the first triode stage to the one point, even including the shielding on the input lead. Shielding of the 12AX7 did not prove necessary, nor was it essential to shield the two short leads from the volume control.

CIRCUIT DIAGRAM OF AMPLIFIER



The circuit is quite a simple one. The first half of the 12AX7 provides enough gain to allow the use of frequency compensating network preceding the second stage. The plate to plate feedback also provides the variable top cut filter circuit.

PARTS LIST

- 1 Chassis 9½in x 6in x 2½in (Baby Playmaster).
- 1 Power transformer 285V 60 mA., 6.3V 2A. 5V 2A.
- 1 Filter choke 15H. 60 mA.
- 1 Speaker transformer 7000 ohm, secondary to suit selected speaker.
- 1 12AX7 valve.
- 1 6BV7 valve.
- 1 5Y3 valve.
- 2 Miniature nine pin sockets with adaptor plates.
- 1 Octal socket.

CAPACITORS

- 3 25 mfd 25V electrolytics.
- 1 24 " 350V "
- 1 16 " 500V "
- 1 16 " 350V "
- 2 .05 mfd 400V paper.
- 1 .02 " 200V midget type (W9)
- 1 .015 " 200V midget type (W9)
- 1 .001 " 200V midget type (W9) or mica.
- 1 250 pf mica
- 1 10 pf mica

RESISTORS

- 2 .5 meg. potentiometers.
- 1 .5 meg. ½w. resistor
- 2 .25 meg. 1w resistor
- 1 .25 meg. ½w resistor
- 1 .05 meg. 1w resistor
- 1 .05 meg. ½w resistor
- 1 .025 meg. ½w resistor
- 2 .02 meg. ½w resistor
- 1 2000 ohm ½w resistor
- 1 1500 ohm ½w resistor
- 1 125 ohm 1 or 3w resistor
- 1 100 ohm 1w resistor
- 1 25/25 ohm centre tapped 3w resistor
- 2 7 terminal tag strips
- 1 4 terminal tag strips
- 1 2 terminal tag strips
- 3 knobs
- 1 miniature speaker plug and socket
- 1 single deck, 3 pole, three position switch
- shielded hookup wire, plain hookup wire, tinned copper wire, 3 core flex, grommets, nuts and bolts, solder lugs

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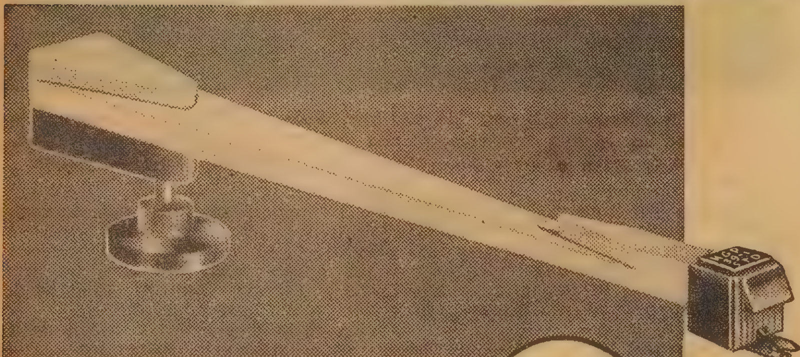

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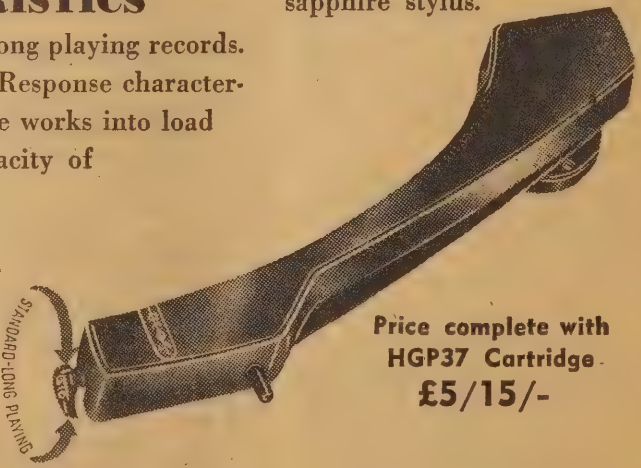
Output 1 volt on standard records. Incorporates easily changeable 0.00025in sapphire stylus.

HGP39-1LP.
Output 1/3rd volt on microgroove records. Incorporates easily changeable 0.0001in sapphire stylus.

HGP38 CHARACTERISTICS

Output 1 volt on standard and $\frac{1}{4}$ volt on long playing records. Tracking weight 10 grammes maximum. Response characteristic smooth with no resonance. Cartridge works into load resistance of $\frac{1}{2}$ megohm and crystal capacity of 1000 picafarads ensures adequate bass response.



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Biasing of the filament network, as was done with most of the Playmaster amplifiers, was also found to be unnecessary, but a centre tap proved essential to remove the last trace of hum. This is provided by means of a centre tapped resistor of between 25 and 50 ohms per side, the value not being particularly critical.

Any high gain valve such as the 6BV7 has a tendency to parasitic oscillation, usually at supersonic frequencies, unless some precautions are taken against it.

STABILISATION

One of the most effective methods now recommended is the one we have used here, namely, a small value of capacitance connected from plate to grid. This provides a measure of negative feedback which is negligible at normal audio frequencies but is considerable at the frequencies at which the valve tends to oscillate. In this case 10 pf was all that was needed to remove the last tendency of the valve to oscillate.

In most cases this precaution will prove sufficient and the grid and screen stoppers may not be necessary. We have included them as a matter of course to cover the isolated case

A further precaution against oscillation is to earth one side of the speaker transformer secondary. The secondary leads are terminated on two of the pins of a miniature four-pin speaker socket mounted on the rear of the chasiss. A similar plug is used to make connection to the speaker.

THE CHASSIS

Construction of the unit is not particularly difficult and should not worry anyone who has had a little previous experience in set building. However, there are a few points worth noting, which will make things easier.

The chassis is the same as that used for the original Playmaster Baby and should be readily available from most dealers. It is well suited to the circuit, the only complication being the minor one that the socket holes are punched for octal sockets, whereas two of the present valves use noval sockets.

This problem can be quite easily overcome in a number of ways. One is simply to cut the correct size hole in a small aluminium plate which may then be fastened to the chassis in place of the larger socket. A better scheme is to make use of ready punched metal adaptor plates, which are readily available and which are designed to suit either seven or nine-pin miniature sockets.

SOCKET MOUNTING

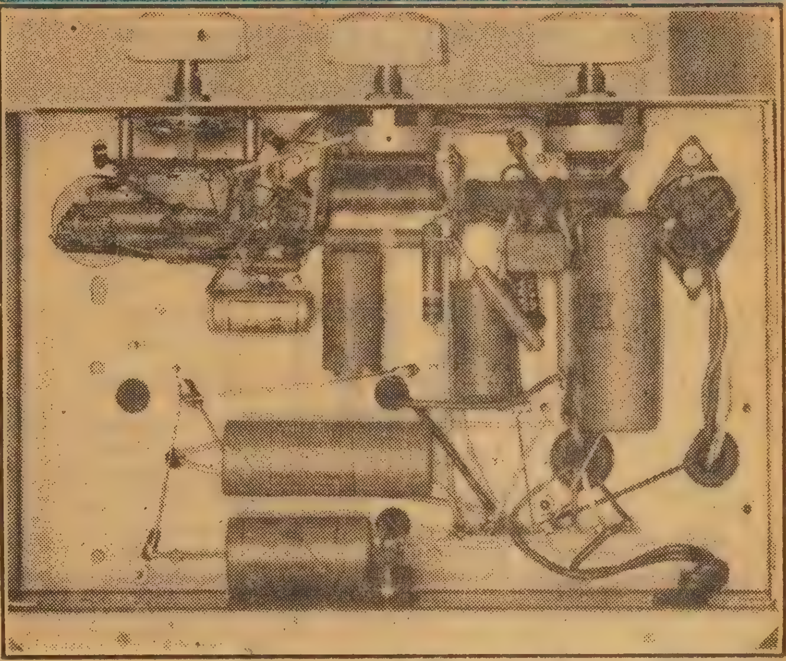
In the case of the nine-pin sockets it is posible that the screws used to fasten the socket to the plate may foul the chassis, this depending mainly on the size of the octal socket hole; it may vary slightly from one chassis maker to another.

One way of overcoming this is to rivet the sockets to the plate and there is no reason why you should not do this yourself if you feel so disposed. We adopted another approach, using countersunk screws and countersinking the holes in the mounting plates slightly. This arrangement worked very well and made possible a perfectly rigid job.

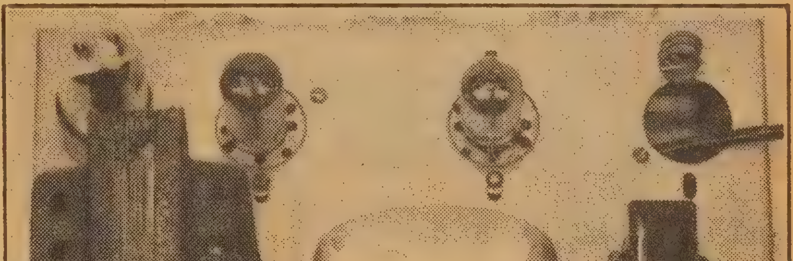
We spent some time with a CRO checking the orientation of the speaker transformer, relative to the power transformer, for minimum hum pickup. We found, more or less as we expected, that this occurs with the core of the two transformers at right angles and the speaker transformer exactly in line with the centre of the power transformer. Since you will have to drill the mounting holes for this component it is worth while taking a little care in placing them.

You can check this point for yourself quite easily. Simply leave the mounting of the output transformer until after you have mounted the power transformer and wired it to the appropriate sockets. After this, the power cord can be installed and the unit plugged into the mains without any valves in position.

VIEWS ABOVE AND BELOW CHASSIS



This underchassis picture should help in the wiring and layout. The compensation switch is at top left, with the tag strip holding the compensation components just below it. The volume control is in the centre and the variable top cut filter at right.



The layout of the major components can be judged from this picture. The power transformer is on the left, then the speaker transformer, with the filter choke on the right. Note the angle of the speaker transformer.

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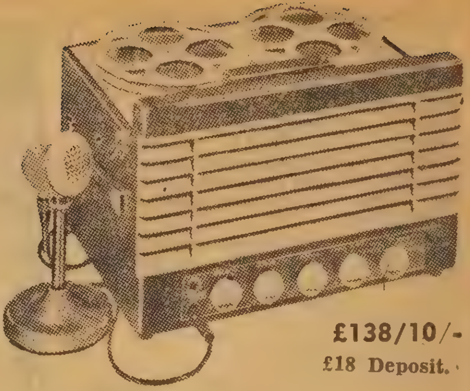

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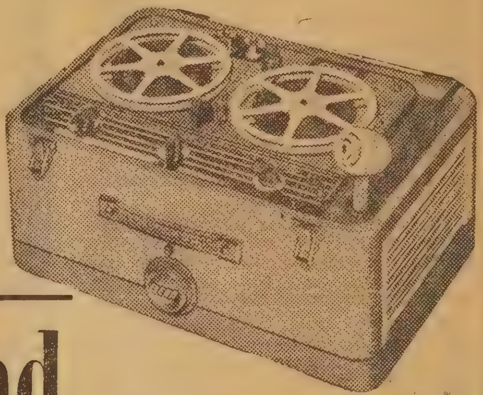
£18 Deposit.



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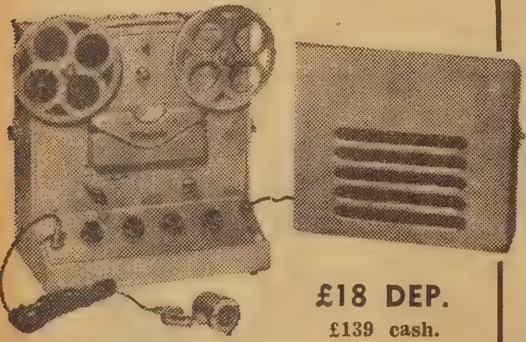

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Exclusive press-button control, two speeds, twin tracks, 2 hours' recorded music or speech on each reel. Condenser microphone, special speaker. Grundig is ideal for music, parties, dictation.

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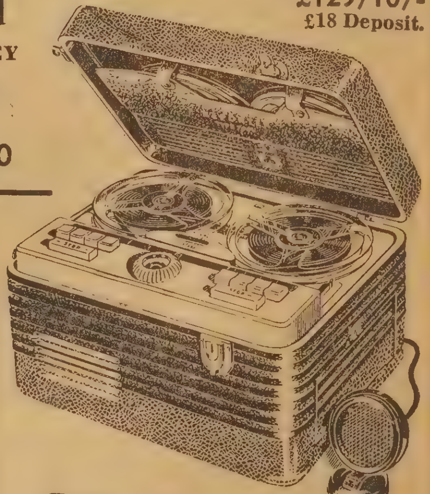
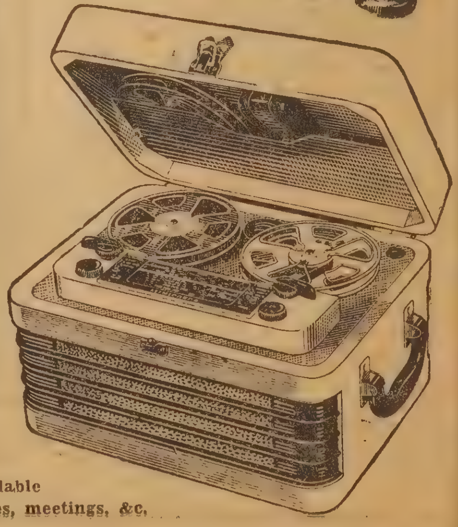


MINICORDA RADIO TAPE RECORDER

£18 DEP.

Use it as a mantel radio and record straight from it; an hour of music or speech on one reel of tape. Records, plays back, erases. Magic-eye tuning. Microphone included.

Cash, £115.



Tape Recorders are available for hire for parties, dances, meetings, &c.

Connect the secondary of the output transformer temporarily to the speaker voice coil, make sure that the primary leads aren't shorting and sit the output transformer in position on the chassis. If the hum is going to be serious, you will hear it in the speaker as the transformer is moved around.

A seven-terminal tag strip is used to terminate the primary leads of the power transformer and also provides anchor points for some other circuits. The secondary leads can go straight to their components, the HT leads to the plate pins of the rectifier socket, the 5-volt filament leads to the rectifier filament fins and the 6.3-volt leads to the filament pins of the 6BV7. The centre tap of the secondary goes to chassis.

SOCKET ORIENTATION

When mounting the sockets it is desirable that they be correctly orientated, as in the original version. This ensures minimum lead, length and logical wiring layout. The 12AX7 should be mounted with pin 6 closest to the 6BV7 socket, and the 6BV7 socket should have pin eight closest to the 12AX7 socket. Orientation of the 5Y3 socket is not critical.

The filament leads should now be extended to the 12AX7 and some consideration given to the bonding of the various earth points on the chassis. With any steel chassis it is unwise to rely on the chassis itself as a return path, due to the poor connection which is likely through the chassis paint or due to rust and corrosion.

For this reason all nominal earth points should be connected together by means of tinned copper wire of 18 or 20 gauge. Solder lugs should be placed under likely mounting bolts to assist in this regard.

Now the wiring proper can be commenced. In most cases the components can be supported by their own pigtails but in a few cases tag strips are used to help out. One is a four-terminal strip alongside the 6BV7 socket. This serves to terminate the HT end of the two .25 meg. plate load resistors for the 12AX7 as well as the coupling capacitor to the grid of the 6BV7 and the grid stopper resistor for the same valve.

Note the HT supply to the first triode is supplied through a decoupling network of .05 meg. and 16 mfd.

Two terminals on the power transformer tag strips are used to terminate the positive end of two electrolytics. One is the 24 mfd 350-volt second electrolytic of the main power supply and the other is the 16 mfd decoupling capacitor. A two-terminal tag strip between the transformer tag strip and the 6BV7 socket serves as a HT point and to terminate the 6BV7 screen stopper (100 ohm) and the .05 meg. decoupling resistor.

A seven terminal strip is mounted near the switch and running parallel with the front of the chassis. This can accommodate all the components associated with the compensation network and makes possible short and direct wiring to the switch. The capacitors used in the network may be of low voltage rating (apart from the coupling capacitor) and the midget W99 types are ideal. In some cases it may be necessary to parallel two values to secure the wanted one but there is still plenty of room, should this be necessary.

SWITCH DETAILS

We mounted the switch with the common of Sla toward the volume control and the three contacts of this section toward the lower edge of the chassis. The common of Slc should point almost straight at the top of the chassis. With this arrangement the wiring is short and simple.

Note that one of the idle contacts on the switch, actually pin 3 of S1b, is earthed. This is to prevent signals from the pre-amplifier stage from leaking thorugh into the main amplifier when it is set to the crystal pickup position.

We deliberately avoided specifying input connectors for the two channels in order to allow the builder to select his own according to his requirements. For the high level input for crystal pickup no special precautions are necessary and a standard terminal arrangement will serve.

For the low level input more care is necessary and any connector should, ideally, be shielded to minimise hum pickup. About the simplest scheme is a length of shielded cable which may be connected to the pickup leads at a point remote from hum fields. If something more elaborate is required a simple microphone connector would be ideal, but mounted alongside the 12AX7 socket to avoid hum fields.

Due to the relatively low input impedance of this channel, which is in keeping with most magnetic pickups, it is not even necessary to use the more expensive variety of co-axial cable. Unless the run to the pickup is very long any good quality shielded hookup wire should be quite adequate and not cause any serious losses.

To identify the controls and the positions of the compensation switch some kind of label is required. This may be a simple affair consisting of some careful hand lettering on white card or it may be a more elaborate version produced by a commercial engraver. You please yourself in this regard but something is necessary to avoid confusion.

Which just about covers the points you need to know in order to build this amplifier. Having built it we feel sure you will find it an ideal unit which is capable of giving a first class performance at a moderate cost.

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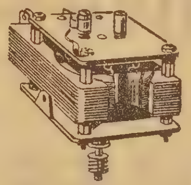

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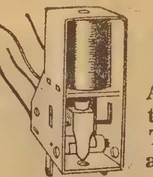

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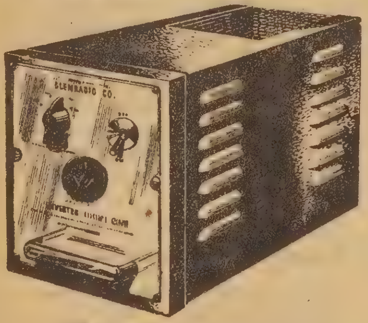

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4 RENWICK STREET, LEICHHARDT, SYDNEY.
LM4545 **LM4545**

BUILDING A ONE-VALVE RECEIVER

(Continued from Page 75)

right for a 1½in former, 86 turns for 1¾in and 69 turns for a 2in former. Obviously, somewhat thicker wires can be used with the larger formers without making the coils unduly long.

The figures, as quoted above will serve as a good general guide but they may not be exactly right. If you find that all the stations are tending to crowd toward the end of the dial where the capacitor plates are out of mesh, try reducing the number of turns on the grid coil.

If they crowd at the other end, add a few turns.

THE REASON

The point behind this is that the tuning range of the set is governed by the inductance of the coil and capacitance of the variable tuning condenser.

We have specified this latter as being a .0004 mfd. type, so that the coverage largely depends on how you wind the coil. If you put on too many turns for the size of former you select, then the coil will have too much inductance and the tuning range will move too high in wavelength (or too low in frequency)

Instead of stations like 2CR coming in with the tuning capacitor plates almost in mesh, they will come in with the plates well out. Then, as you begin to tune the higher frequency stations with the capacitor further out, you will reach a stage where the capacitor plates are right out but with some stations still not covered. Clearly you would need to reduce the inductance of the tuned or grid winding by removing a few turns.

And, of course, the reverse is true. Too few turns to begin with gives too low an inductance and may leave you with the capacitor plates fully in mesh and stations at the lower frequency end of the band still not covered.

PRIMARY WINDING

The aerial primary coil can generally afford to have about one sixth or one seventh of the number of turns on the grid winding.

This is only a general guide, however, and results can often be improved by careful experimenting.

Two separate effects have to be considered. In the first instance the primary winding provides the means of feeding the incoming signals to the tuned grid circuit. On the surface of things, this might simply suggest that the signals would be transferred most effectively by means of a large primary wound very close to the tuned winding.

However, against this, the aerial circuit tends to "load" the tuned winding, reducing its selectivity and therefore its ability to separate adjacent stations. The larger the aerial, the more noticeable will this loading effect be.

The second point is that the loading effect can interfere with smooth operation of the reaction circuit. In fact, in an extreme case, it may prevent the reaction from working at all over whole sections of the tuning range.

The logical course, therefore, is to decide on the kind of aerial you want to use with the set (the larger the better) and then proceed to adjust the number of turns on the primary winding till you get the best all-round balance between signal strength, selectivity and smooth operation of the reaction circuit.

Lastly, the reaction winding is normally wound with fine wire, simply to get it into a reasonably small space. We put on 70 turns of 30 B & S (32 SWG), representing, therefore 0.7 times the number of turns on the grid winding. This might well represent a handy rule of thumb.

We needed that many turns to get reliable reaction for the 30 type detector, using only 13½ volts on the plate. With a somewhat higher plate voltage, the number of reaction turns could be cut down, making the set more smooth to operate.

EVEN OSCILLATION

The idea is to so proportion the windings that the set will go in and out of oscillation all over the band with the reaction capacitor operating within its normal limits of full in and full out.

Very obviously, it is a good plan to decide definitely on what order of plate voltage you are going to use, so that the reaction winding can be adjusted to suit.

If you use a 45 or 67½-volt battery and a high-gain valve as well, the reaction may even become rather difficult to control. In this case, a .0005 mfd. fixed mica capacitor may help matters, connected between earth and the point where the phones and RF choke join.

As we've explained on many previous occasions, the best listening point with a reaction set is with the reaction capacitor turned just a trifle farther out than the point where it makes the set whistle.

The whistle may or may not worry you but they will certainly cause interference in your neighbor's sets if they are trying to listen to the same station. And that isn't nice.

This radiation of interference can happen, even when the set is operating on a low plate voltage, for example on 13½ volts as shown in the diagrams.

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100 ASSORTED—over 30 values
50 1 watt, 25 ½ watt, 25 ¼ watt

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with twin crystal heads

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Standard base globes 12/6

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12/6 doz.

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.25, .1, .02, .008	600v 9/- doz.
.5, .25, .1	400v 7/6 doz.
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4 BANDS 1.5 to 9 megs.

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suit P.P. 6L6's etc.

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6C4	12/6	717A	12/6
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812	£3	6AJ5	12/6
12H6	7/6	12SN7	12/6
6SK7	12/6	6Y6	17/6
6SQ7	12/6	12SR7	12/6
6SA7	12/6	38	12/6
6AC7	12/6	1J6	12/6
47	12/6	1K6	12/6
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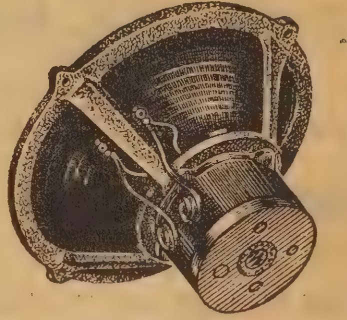

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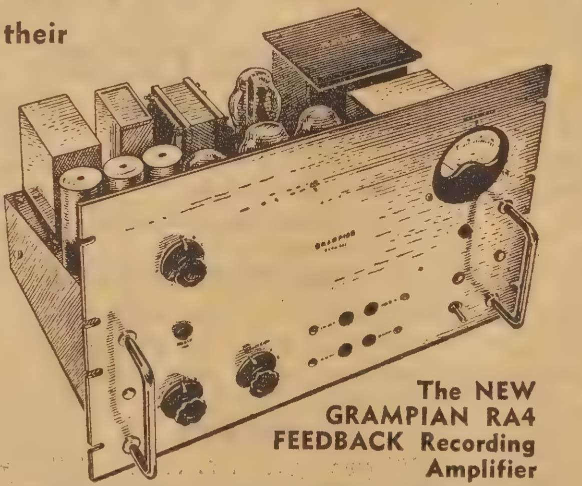

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★ **Distortion:** Of the order of 0.1 pc.

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Here's your answer, Tom!

No matter how adept Tom may be with a plough or a milking machine, he is obviously no expert in modern physics. But then why should he be? It goes to his credit that he takes an interest in it at all.

WE say this because Tom's first question has to do with instruments that are very much in the ews at present—Geiger counters.

What is a Geiger counter used r, and anyway, what are Geigers?

Though you don't know it, Tom, our question could have a very ersonal background. One can only uggest that Geigers would be the elatives and offspring of Mr. Geier himself.

You see, Messrs. Geiger and Muller were two gentlemen who originted the "Geiger-Muller Counter," r the "G-M Counter", as it is somemes called. Unfortunately for Mr. Muller, his name is often dropped ompletely and we thus get the term 'Geiger Counter".

When he saw your question, one member of our staff laughed in a ather uncouth fashion and suggested that Geigers are what modern rofessors count when they can't go o sleep.

Our artist did the rest.

To be a little less facetious, Geiger-Muller counters are designed to "count" or register the passage of lectrical rays or particles.

They incorporate a special tube which passes a pulse of current each time a charged particle penetrates the nstrument. This pulse is amplified and made to cause a click in a pair of headphones, so that, in operation, a Geiger counter produces a series of clicks to which the operator listens.

Alternatively, the pulses may be amplified in a different way and made to register on a meter calibrated to read directly in terms of so many "counts per minute".

A Geiger counter generates what is called a "background count", which is caused by cosmic particles coming from outer space. These cosmic particles are raining down upon the earth at all times like a continuous shower and produce a background count of approximately one per second.

However, when the counter is brought near a piece of radioactive material—radium, uranium, &c.—rays or particles radiated by the material also penetrate the instrument and cause it to click more rapidly.

A mildly active specimen will raise the count to about three times background. This figure will increase with more active specimens until, in extreme cases, the clicks are so rapid as almost to merge into a continuous tone.

When you come across specimens of that order, Tom, you don't even wait to milk the cows. You peg out a claim, then race off to find someone who'll give you a few million for it.

EASY LIVING

After that, you lose all interest in Radio and Hobbies and concentrate on deep-sea fishing from the cockpit of your luxury cruiser in the waters off Bermuda.

But you have to find the uranium first. As our staff member, Ray Howe, often says . . . "That's the hard part".

Incidentally, Tom, Ray wasn't the uncouth person who made the remark about "counting Geigers". That's as much as we can say, because we promised Phil Watson not to tell.

Tom's next question is quite a long one; in fact, it occupies best part of a page in a letter. Summarised, it boils down to this:

My new amplifier using a 6J7 and 6V6 is good, but not as good as the old 57-47 job. This one has a 25,000 ohm cathode resistor for the first valve and a 0.5 mfd bypass. The new one uses 2500 ohms and 25 mfd. Since the new values are not as good as the old, why the change?

I think that would qualify as a "loaded question", Tom, because it is based on an assumption that might well be open to doubt.

Let's not answer it in that form at all.

The value of a bias resistor isn't fixed for any particular valve. It will vary with the supply voltage, with details of the plate circuit and the purpose for which the valve is being used in the particular set.

Where a pentode is involved, as in this case, the screen circuit also has a bearing on the optimum bias.

The 57 and the 6J7 happen to be electrically identical apart, of course, from the heater voltage. One might normally expect them to use the same bias resistor, but, as we've just pointed out, this would only be the case if the operating conditions are identical in all other respects.

What about the plate load resistor and the screen supply?

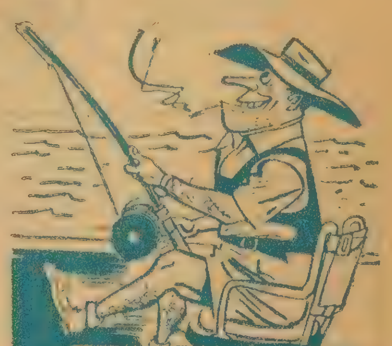
In actual fact, neither the 57 nor the 6J7 would normally use a bias resistor as high as 25,000 ohms, at least when functioning as an audio amplifier. The 2000-ohm figure is much more typical.

BIASED DETECTORS

It seems likely that the combination of 25,000 ohms and 0.5 mfd. is a carry-over from the days when 57's were so commonly used as biased detectors in the early AC superhets. By applying a deliberately high value of bias in the cathode circuit, the operation of the valve was made sufficiently non-linear for it to operate quite efficiently in this role.

Amazingly enough, people often feed a pickup through the same stage, without changing the bias, thereby presuming that it would now amplify without non-linear distortion!

If you are using your amplifiers as part of a radio circuit, with the 57 or 6J7 as the detector, the higher value of bias resistor would be the right one to use.



However, if the amplifiers are being used with pickups or with radio signals AFTER detection, then the 2000-ohm figure is more likely to be the right one.

Because the 57 and 6J7 are electrically identical, there should be no difference between their performance in an ordinary amplifier. However, the 6V6 has slightly higher gain and higher power output than the 47, so that the new amplifier should have the advantage in both respects.

However, Tom, we're wondering whether the new amplifier incorporates a negative feedback circuit, which will greatly reduce the gain but improve the tonal quality. Perhaps you're just assuming that the old amplifier is "better" because it seems to be more sensitive.

In other words, Tom, there's a lot more to the matter than just the value of a bias resistor. It concerns the way you're trying to use the valves and whether you are basing judgment on gain or on quality or both. Actually the job using the new valves should be slightly the better of the two and there's something wrong if it's not.

METAL LOCATORS

I am very interested in the idea of locators to detect metals underground. Could you describe one in your paper, preferably without using radio valves?

There's no doubt you make life very hard for us, Tom.

We may as well begin by defining just what metal locators can and cannot do.

We understand that they can locate large metal pipes several feet underground and smaller ones close to the surface. They can locate pieces of metal about the size of a plate, their best-known application being the location of land mines buried just beneath the surface of roads and tracks during wartime.

But they can't locate small metallic pellets or grains of the type likely to interest prospectors. There's not much future, therefore, in wandering around with a metal locator, hoping to discover a new goldfield.

Most metal locators operate on the principle of two radio frequency oscillators, which are adjusted to operate on exactly the same frequency. Their outputs are fed to a detector circuit, which does not produce any audible note in the earphones provided the oscillators are not disturbed.

One of the oscillators, however, is connected to a very large tuning coil, wound rather like an ordinary loop aerial. This mounts on the end of a rod and constitutes the "search" coil.

Waving this coil above ordinary dry ground does not greatly affect it but, immediately it passes over a mass of metal, the inductance of the coil is affected. This changes the frequency of the oscillator and produces an audible "beat" note in the phones.

USES VALVES

The whole operation of the device relies on the use of valves and it's hard to imagine how you could make a satisfactory substitute without using them.

Of course you could use transistors, Tom, but they would merely substitute for valves and not make the circuit any the less critical in operation. And they'd cost you a lot more!

Afraid we can't help you much on that request.

Is there any material that wireless waves will not penetrate?

Yes, Tom, there are plenty, as you will have realised from what has been published in the last couple of issues.

Wireless waves will not penetrate thick metal sheet or two suitably arranged layers of thin metal.

Only last issue, we described the construction of a typical screened test room, as used in laboratories. These use a double layer of gauze or chicken wire to keep radio waves out.

They won't penetrate underground nor very far below the surface of water.

Wireless waves are not impeded, however, by what we normally regard as insulators. A coating of insualtion on the aerial does not prevent it from picking up signals. The reason for this is simply that wireless waves, in the sense you are using the term, are in the form of magnetic and electric fields. Just as a permanent magnet will attract a needle through a sheet of paper, so can wireless waves affect a metallic conductor inside a coating of insulation.

Is it possible to use water power to turn an electric generator?

Yes, Tom, but it's not a very practical scheme for the majority of Australian experimenters.

HYDRO-ELECTRIC SCHEME

Right now, the authorities are planning to use water to generate huge quantities of electricity in the Snowy Mountains area. But what an enormous job it is to dam the water in the first place and then direct it in channels where it will develop sufficient speed and pressure to run the turbines.

The only people who could hope to do this in even a small way would be the few who happened to live near a waterfall or in some other situation where they could arrange for a continuous flow of water at high pressure to work a small turbine.

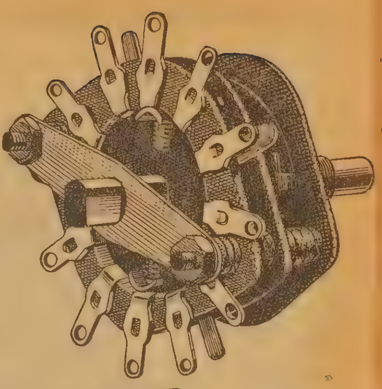
The other alternative would be to make use of the more sluggish flow of a river or stream. This would entail a large waterwheel suitably geared so that its relatively slow rotation would spin a generator at high speed.

Generally speaking, favorable situations and streams that never dry up or flood are so few and far between, that most people would prefer to put in a petrol-electric set and be done with it.

And in the cities, of course, where water is laid on, the power is also available in a form a lot more convenient and cheap than one could hope to generate by letting the tap run.

As far as we can see, Tom, the idea would be no more than a novelty to most readers.

On hand in the BBC library are recordings of sounds at various famous places, such as the stamp of feet when the guard is changed at Buckingham Palace, or the challenge of the sentry during the Ceremony of the Keys at the Tower of London. Recently engineers went to the British Museum to record the silence in the reading room. The roof of the great room is domed, which provides a loud echo, and the silence of this celebrated place emerged on the recording as a great roaring sound of heavy breathing and rustling of pages, punctuated by loud bangs whenever an engrossed reader dropped a book, or someone shut a door.



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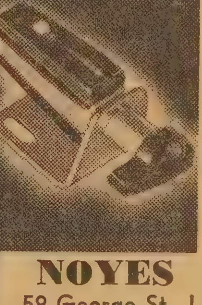

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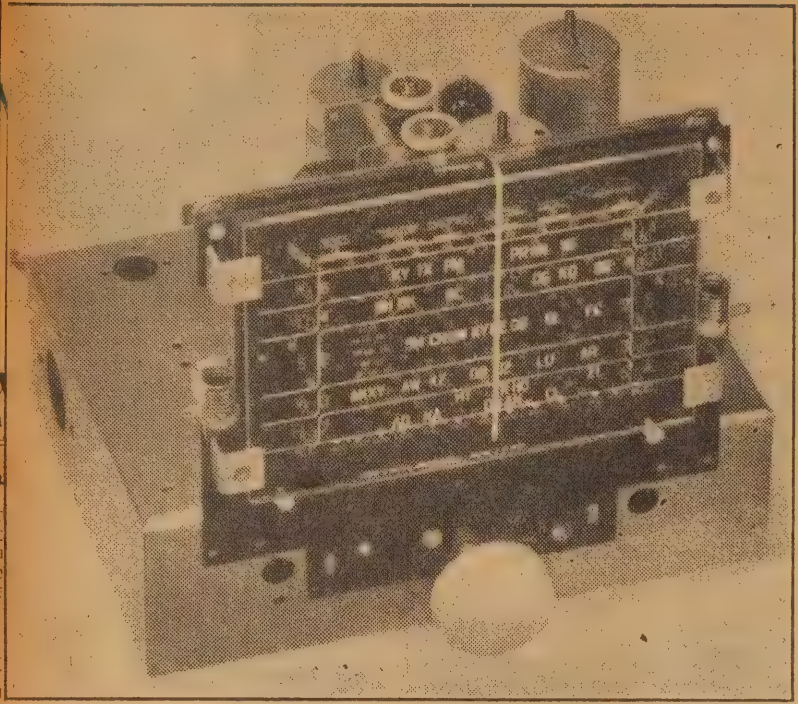


Here is a front view of the tuner built on a standard chassis. The two trimmers seen on the gang are across the RF and oscillator sections. The cans at the rear are the IF transformers.

THE R & H STANDARD TUNER

Many people such as country listeners cannot successfully use wide range tuners. To them, reasonable selectivity and high performance are the things that count most, whereas wide range tuners bring in too many heterodynes and other unwanted noises. This tuner may be used with the Playmaster and Standard amplifiers, and is suitable for almost any similar type. Its addition converts the outfit into a very high powered radiogram.

by Raymond Howe

THE fundamental idea behind the Playmaster series of amplifiers, control units and radio tuners was high quality reproduction on both records and radio programs. The amplifiers catered for various power output needs and the control units for various degrees of recording compensation and tone control.

The radio tuners followed one theme—that of providing wide-band reception of strong stations. For instance the No. 1 tuner employed a superhet circuit with provision for switching resistance - capacitance coupling into circuit in lieu of the scond IF transformer. The No. 2 tuner used the TRF principle with resistance-loading of the tuned circuits.

The Playmaster Wide-Band Tuner of the August, 1952 issue, introduced a new approach to the problem. It employed the superhet principle with 1900 Kc intermediate frequency and a bandpass aerial circuit.

These results were duplicated with the No. 2 Wide-Band Tuner of the July, 1953, issue, but utilising standard 455 Kc IF transformers with the added facility of "wide-band" and "normal" reception.

However, many amplifier users cannot successfully use wide range tuners—country readers for instance. They are able to enjoy the high quality record reproduction of the Playmaster amplifiers, but are faced with poorer listening conditions due to low signal strength from stations and higher noise level than those in the city.

Enjoyable wide-band reception requires relatively good signal strength to over-ride electrical noise, the impact of which increases with the increase in the pass-band of a tuner.

It is in response to requests from country readers that we produced this new tuner. Although it was designed to fit in with the Standard or Playmaster series of amplifiers, it may be used with any amplifier. It will give good reception of radio programs in difficult areas without any pretence to wide-band results.

SUPERHET CIRCUIT

It is a superheterodyne circuit with one stage of RF amplification and one stage of IF amplification. It has the same degree of selectivity as a standard commercial set, but the presence of the RF stage found only in the larger commercial sets, will enable weak stations to be played with the best signal-to-noise ratio.

Tests of the prototype in our laboratory showed that it is capable of results equal to, if not better, than large commercial sets, and at a current drain on the main amplifier power transformer of about 20 mA.

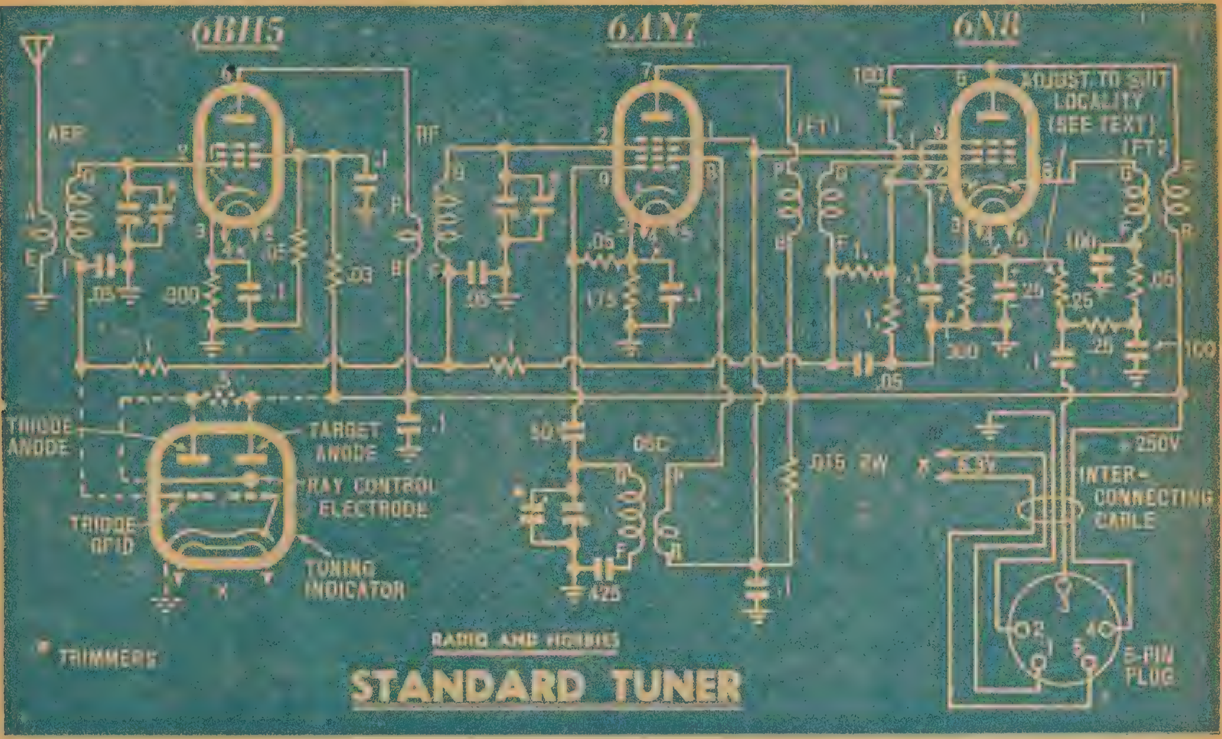
The actual current drain will vary with signal strength, being from about 25 mA with the aerial coil primary winding shorted to about 15 mA when receiving a strong signal. This extra drain is allowed for in both the Playmaster and Standard amplifiers.

The tuner is built on a chassis used for other Playmaster tuners. Connections to it are made with twisted and plaited hookup wire, including one run of shielded hookup wire, all teminating in a 5-pin plug to fit the 5-pin socket at the rear of any Playmaster Control Unit.

To complete the picture, the control unit connects to the amplifier proper through 6-pin interconnecting plugs, to make a 3-unit system.

Treating the circuit design in detail, you will note the use of a valve type in the RF stage with which you may not be too familiar. It is the 6BH5, a miniature medium-Gm, re-

CIRCUIT DIAGRAM OF THE STANDARD TUNER



The circuit design follows along standard lines and carries a few additional components to ensure stability for inexperienced constructors. The adjustment of one of the resistors in the detector diode load to suit local signal strength is discussed in the text. The .1 mfd cathode bypass and the .1 mfd output coupling capacitors may be of 200 volt rating.

mote cut-off RF pentode with a 9-pin base.

We chose it rather than the higher Gm 6BA6 valve because it would give adequate gain and would be less susceptible to general instability in the hands of a relatively inexperienced constructor.

This was followed by a 6AN7, a 9-pin frequency converter, and a 6N8 in the intermediate frequency amplifier stage providing audio detection and AVC voltage in the same envelope.

Unfortunately, we could not provide back-biasing for the valves via the AVC line without considerable modification to the unit interconnecting cabling and the amplifier circuit. It was necessary therefore to cathode-bias each stage separately.

SIMPLE MODIFICATION

If the tuner is used with audio equipment readily open to simple modification, earth the cathodes direct and return the earthy end of the 1 megohm AVC diode load resistor to the high voltage centre-tap of the power transformer on the amplifier, which should be returned to chassis through a 20 ohm resistor. The value of 20 ohms is based on a total transformer secondary drain of 100 mA.

With this connection the filter condenser connected to the rectifier must be earthed not to the chassis but to the centre tap to which the 20 ohm resistor is wired. Otherwise its addition may cause hum.

It would be advisable to bypass the end of the AVC diode load resistor with a .05 mfd capacitor and take the lead off to the transformer centre-tap through a .5 megohm resistor. This biasing arrangement will save you a net total of four components.

The screen voltage for the 6BH5 is obtained from a divider between the HT line and chassis to permit better control by the AVC voltage. The divider consists of two resistors selected to give about 100 volts at their junction under "no signal" conditions.

The AVC line is separately decoupled to each stage through a 1 megohm resistor, and a .05 mfd capacitor for the 6N8 and a .1 megohm and a .05 mfd for the preceding stages.

Here we took the safe approach instead of attempting to save two components by tying together the AVC points of the converter and IF stages.

COMMON FEED-POINT

The only position where we could achieve some economy in the use of components was in connecting together the screens of the 6AN7 and 6N8 and the 6AN7 oscillator anode feed-point.

This point has a potential of about 85 volts under "no signal" condi-

PARTS LIST

- 1 chassis 8½in x 6½in x 2½in (Playmaster Wide-Band Tuners Nos. 1 and 2, &c.)
- 1 miniature 3-section gang tuning capacitor.
- 1 dial with glass to suit gang (USL44 or similar).
- 1 set broadcast coils, aerial, RF and Osc. (suit 6AN7 or similar).
- 2 standard 455 Kc IF transformers, Nos. 1 and 2.
- 3 gang-section trimming capacitors.
- 3 9-pin miniature valve sockets, 1 5-pin plug with cover.

VALVES

1 6BH5, 1 6AN7, 1 6N8.

CAPACITORS

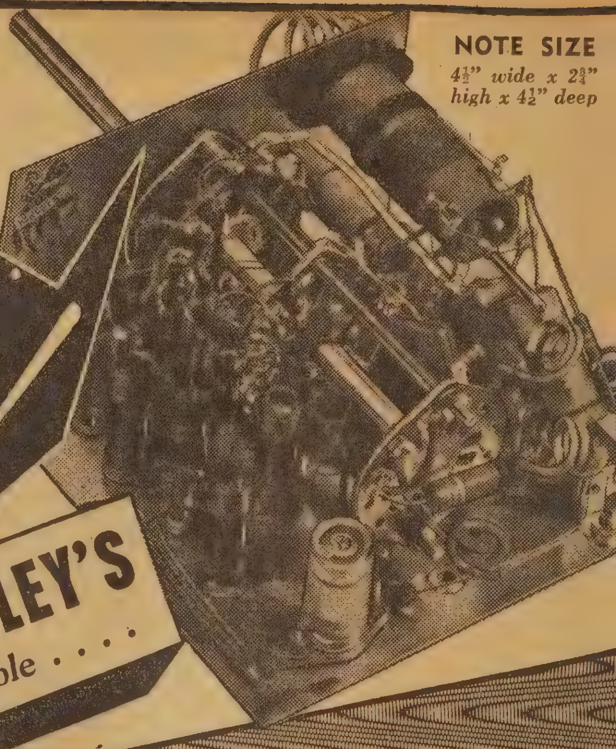
1 25 mfd 40PV electrolytic, 7 .1 mfd 400VW, 3 .05 mfd 200VW, 1 425 pf (low tolerance), 3 100 pf, 1 50 pf.

RESISTORS

2 1 meg. ½w, 2 .25 meg. ½w, 2 .1 meg. ½w, 1 .05 meg. 1w, 2 .05 meg. ½w, 1 .03 meg. 1w, 1 .015 meg. 2w (or two .03 meg. 1w in parallel), 2 300 ohm ½w, 1 175 ohm ½w.

SUNDRIES

1 knob, 2 terminals (1 red, 1 black), 2 4-tag mounting strips, length of shielded hook-up wire, hook-up wire, spaghetti sleeving, rubber grommet, solder lugs, solder, nuts, bolts, star washers.



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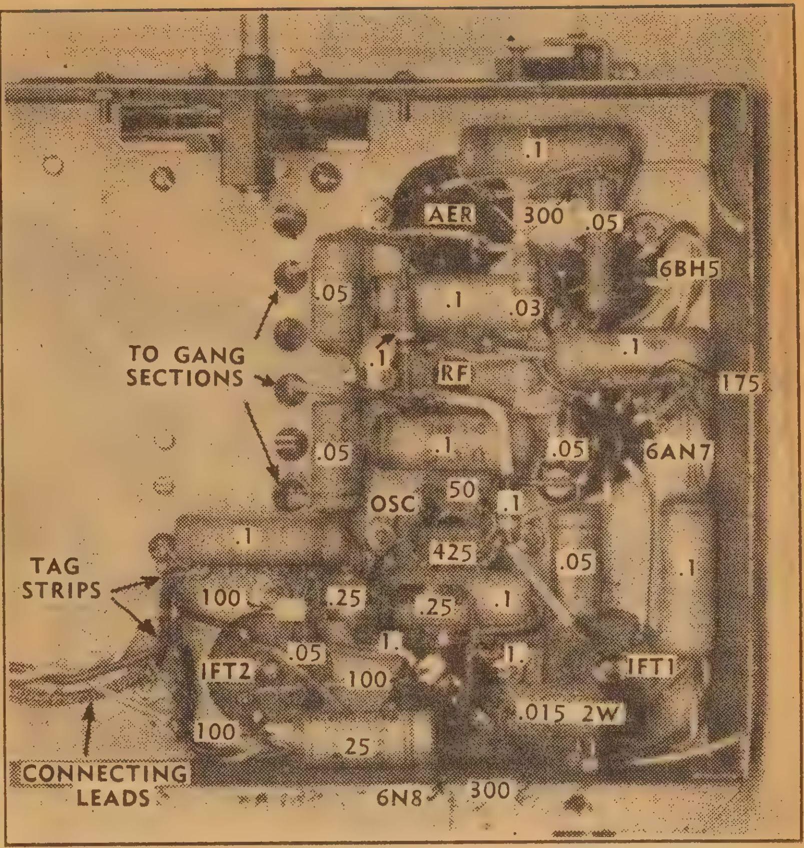
LAYOUT OF STANDARD TUNER



This view shows the section of the chassis n which all components are concentrated. Using this diagram in support of the circuit diagram, you should be able to make a neat job of the wiring.

tions, but due to AVC action on a strong signal, it rises to well over 100 volts.

This rise in voltage is quite in order for these valves because the AVC voltage reduces the element currents considerably. But it does bring up the question of permissible oscillator grid current. Using an oscillator coil designed for the 6AN7, the oscillator grid current would probably not rise greatly above the recommended figure of 200 microamperes.

On the other hand, if you use an oscillator coil labelled for use with such valves as the 6J8G, 6A8G, &c., the closer coupling would produce an oscillator grid current of around 500 microamperes. This can be satisfactorily reduced by shunting the anode winding of the oscillator coil with a resistor of 3000 to 5000 ohms.

GRID CURRENT CHECK

Incidentally, the oscillator grid current is checked by connecting a multimeter, set to read on the 1 mA range, between the earthy end of the .05 megohm oscillator grid resistor and chassis.

We checked on a few simple arrangements to limit the rise in the voltage at the common feed-point but short of providing a heavy bleed circuit or feeding the oscillator anode separately, the maximum sensitivity on weak stations would be prejudiced.

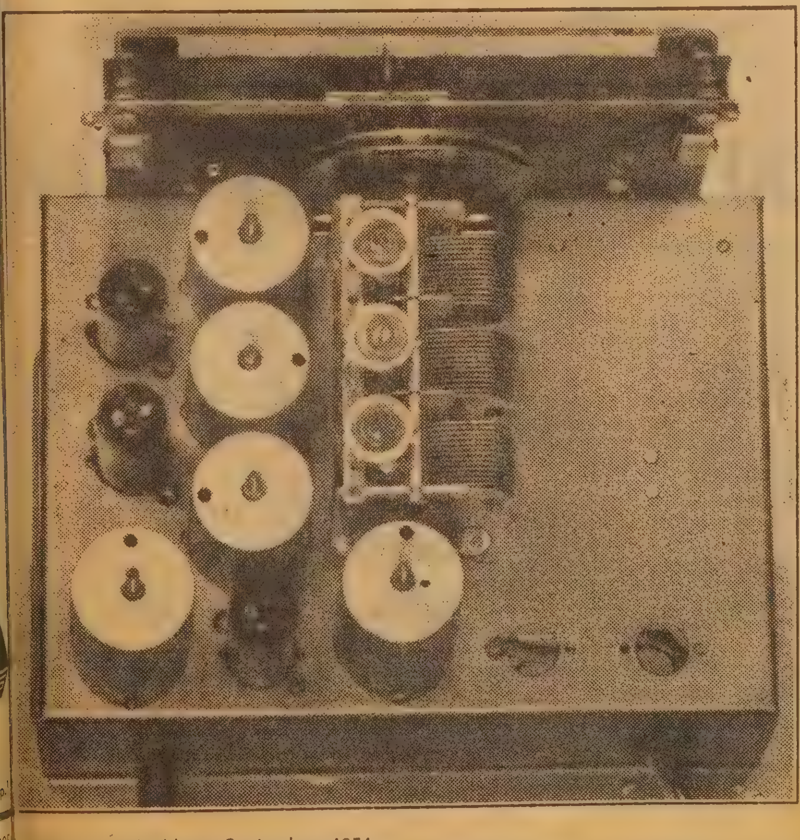
The detector diode circuit carries an RF filter formed by the two 100 pf capacitors and the .05 megohm resistor at the second IF transformer. While in most cases this could be omitted, it is further insurance against instability.

Two resistors are used for the diode load to reduce the audio output fed to the control unit. Too much output will crowd the volume control movement on radio at one end and its action will be too sudden. You can select any ratio of values between these resistors which gives you the right amount of audio from the tuner as long as the total value is about .5 megs. The lower value will be the one which connects to the 6N8 cathode.

VARIABLE CONTROL

Or if you have a .5 megohm potentiometer on hand, it could be wired as the diode load resistance and the output to the control unit taken from the moving arm. This could be mounted as a preset control in one of the vacant holes toward the rear of the chassis and adjusted to give the result mentioned. Once set, it need not be touched again unless the aerial is altered.

As a matter of interest, a little treble boost can be incorporated by shunting the .25 megohm resistor be-



From the top left are the 6BH5, 6AN7 and IFT1, with the 6N8 and IFT2 along the rear edge. The aerial, RF and oscillator follow in that order between the valves and gang to the rear.

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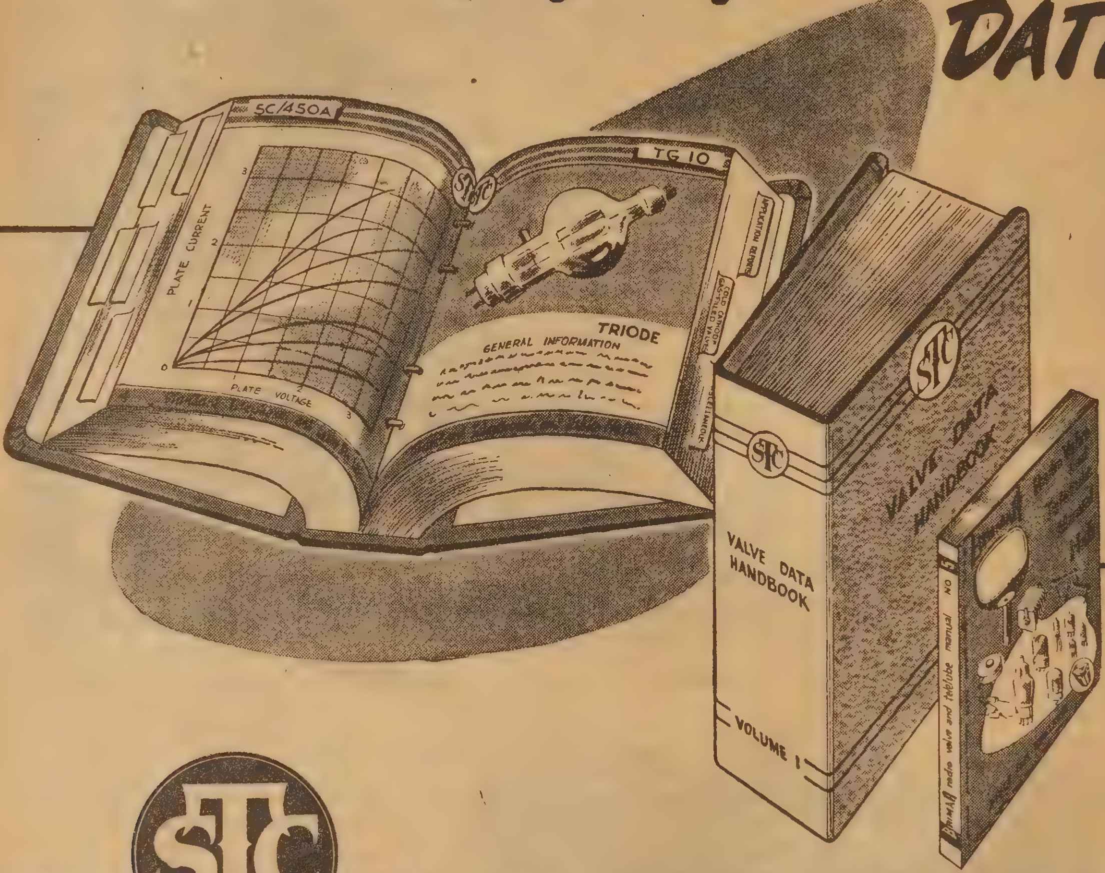

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tween the RF filter and the output tapping with a small capacitor.

If you are interested in adding a "magic eye" tuning indicator to the unit, we have shown the appropriate connections dotted on the circuit diagram. The indicator could be mounted separately in the cabinet with its own escutcheon or it could be fitted to the dial back-plate and viewed through a suitable cut-out.

The only modification to the chassis was to enlarge three of the valve holes to take the 9-pin miniature socket. We intend to amend the chassis blueprint accordingly.

Unfortunately, we had insufficient time to prepare an underchassis wiring diagram, but the coded underchassis photograph will assist you in locating the minor components.

It is simply a matter of noting the position of components in the circuit diagram and identifying them in the photograph. With this in mind, you can select the most suitable position for each component.

COMPONENT ORIENTATION

Obviously, a satisfactory layout is dependent upon a logical orientation of the valve sockets, coils and IF transformers. The point of reference for the valve sockets is the gap between pins 1 and 9. For the 6BH5, this is toward the RF coil, for the 6AN7, it is toward the oscillator coil and for the 6N8, it is toward the first IF transformer.

For the coils, the grid pin of the aerial and RF coils is toward the valve sockets, while that for the oscillator coil is toward the gang. For the IF transformers, the "B" pin of IFT1 is in the corner while IFT2 is rotated a half turn from this reference.

When mounting the major components, see that good contact is made with the chassis, either by using star washers under the nuts or scraping the paint away from around the holes. This applies also to the bolts holding the valve sockets.

We used solder lugs under the bolts holding the valve sockets, the nuts of the RF and oscillator coil cans nearer the gang, and the rearward nut of the IFT2 can. Two 4-tag mounting strips are secured around the IFT2, one under the front nut and the other in a hole near an adjacent valve hole.

GANG AND DIAL

It will be necessary to cut ¼in off the gang spindle to enable it to fit into its place. When mounting the dial, remove the screw holding the drum drive to the backplate and "float" the drive on the gang spindle, securing the grub screws so that the dial pointer has an equal amount of overlap at each end of its travel.

It is best to lay in first the straightforward wiring runs between coils, valve sockets and IF transformers. The other components can then be mounted in place without having to thread wires under or around them. The lead between the aerial coil and the aerial terminal is taken toward the rear along the outside face of the chassis to prevent undesirable coupling with the remainder of the circuitry.

Do not forget to earth the centre spigot of each valve socket to a solder lug held under the bolt near the gap in the pins. This spigot acts as a shield between the input and output pins of the valve and must be earthed to prevent instability.

The heater circuit in the tuner should not be earthed as it is supplied from the amplifier proper in which appropriate earthing is carried out.

This precaution applies to both the Playmaster series and the Standard series of amplifiers. If the tuner is used with another design, you should check the arrangements of the heater circuit in the amplifier.

Looking at the underchassis photograph, the .05 mfd capacitors for the aerial and RF AVC circuit are directly under the gang with the 6BH5 and 6AN7 screen bypasses at right angles and adjacent to them. The 6AN7 cathode bypass is between the first two valve sockets and that for the 6BH5 is near the aerial coil.

The 6N8 AVC bypass is between the IFT1 and the 6AN7 socket, with the HT line bypass parallel to it against the side of the chassis. The 6N8 cathode bypass is between that socket and the oscillator coil. The .1 mfd output capacitor is on one of the mounting strips.

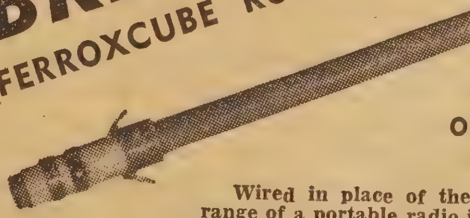
The use of an existing chassis design does not leave a great deal of space for the components and is is advisable to use the miniature size wherever possible. The half-watt size of resistors is used in all cases except for the screen feeds.

The connecting leads from the control unit terminate on one of the 4-tag mounting strips and pass through a rubber-grommeted hole in the rear face of the chassis. The lead carrying the audio output from the tuner should be in shielded hook-up wire. The heater leads should, preferably, be twisted together and all of the leads plaited or sheathed in insulating sleeving for protection and neatness. At the other end, the leads terminate at a 5-pin plug.

Finally, don't forget to mount the trimmer capacitors on the gang. The top plate of each trimmer should be the one which solders to the gang frame.

We would imagine that in many cases the alignment of the tuned circuits would be carried out without the aid of a service oscillator,

(Continued on Page 109)



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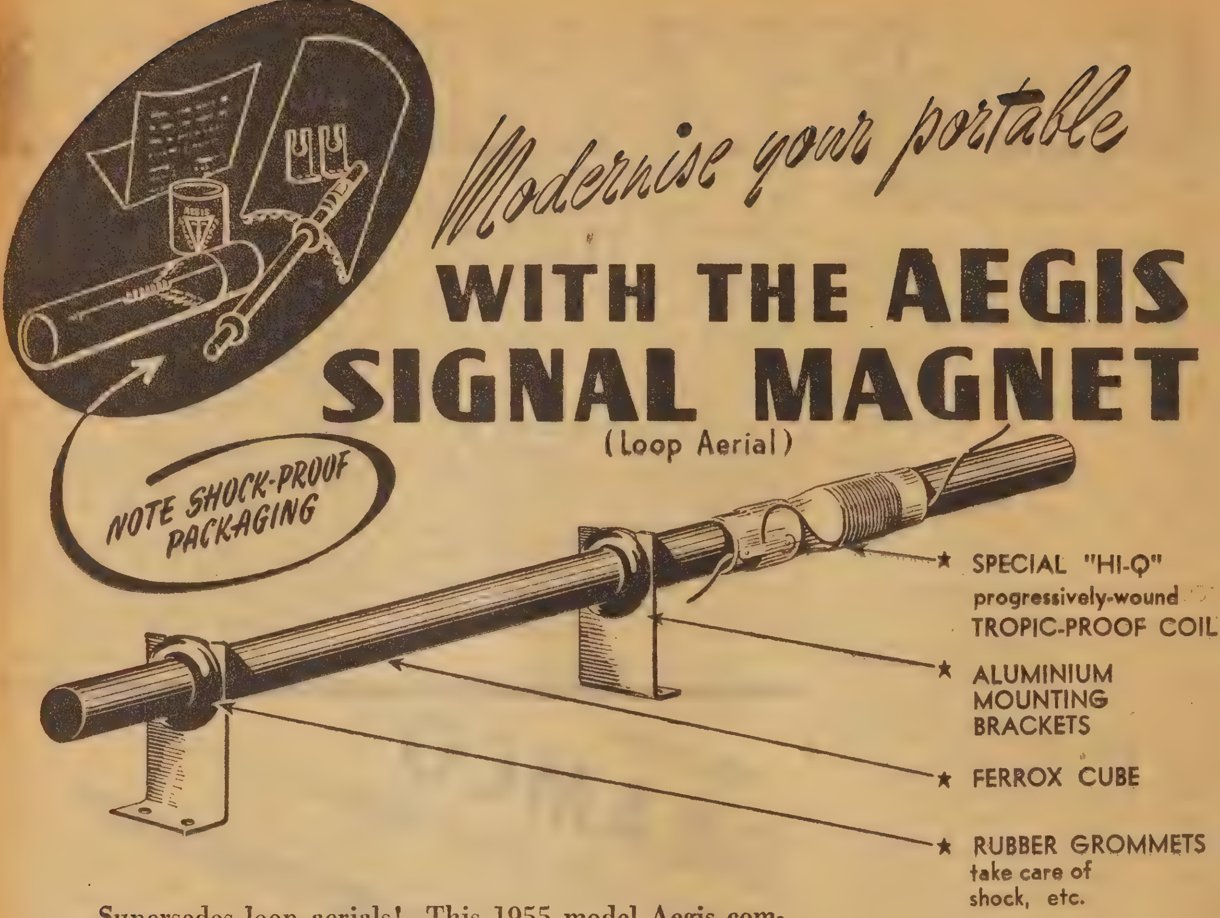
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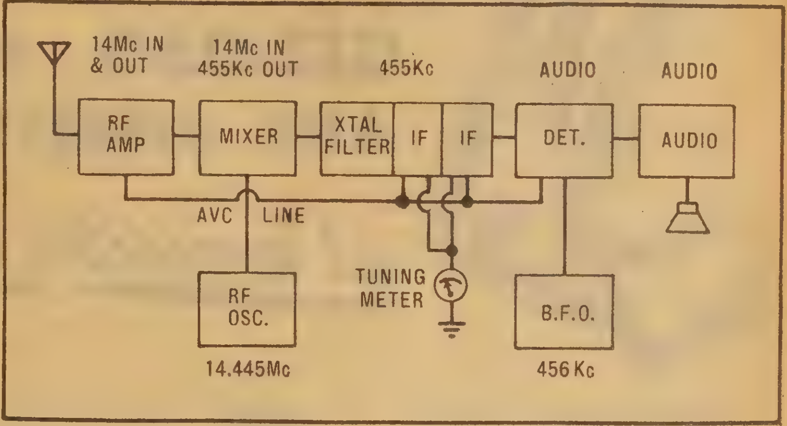
GETTING YOUR AMATEUR LICENCE

In this article we have tried to present the basic theory of a short-wave receiver in concise but accurate form. From it you should be able to extract the information the examiner will want to know, but you would be wise to amplify these condensed descriptions by reading back into your theory textbooks so that you understand the meaning of all the terms used.



A block diagram of a single conversion superhet, using an RF stage, separate HF oscillator, mixer, two IF stages at 455Kc with crystal filter, detector, two audio stages, BFO and tuning meter. An AVC line is indicated, using one of the detector valve diodes. The mixer valve is not controlled, although, if it were a pentagrid or triode hexode, it could be.

EVERY examination paper will have a question or two about receivers. You will nearly always be asked to draw a block diagram of a superheterodyne receiver and explain the operation of the various sections. This is a good question, for it tells the examiner whether you really know how a receiver works.

Another popular question is to select various receiver features such as the mixer, crystal filter or beat oscillator and ask for a circuit, approximate component values and an explanation of operation.

So you see there is no way out of learning all about a typical superheterodyne. Fortunately this isn't very hard, for most people have built dual-wave receivers at one time or another, and already have a good idea of what goes on. Fundamentally there is little difference between receiving short waves and receiving the broadcast band.

RECEIVER FUNCTION

First of all, let us list out the things a good receiver should do.

1. It should tune in phone and CW (Morse Code) signals on the amateur bands. Normally a single receiver is useful from 3.5 Mc to 28 Mc. Bands may be changed by using switched coils or plug-in coils. For higher frequencies changes to the design are needed for best efficiency, and these will be dealt with at a later date.

2. It should be sensitive to weak signals as many amateur stations are not strong.

3. The noise generated in the set by the valves should be low, so that weak signals are not drowned out.

3. The set should be able to separate the wanted station from all other signals, including images or spurious responses generated in the set itself.

4. It should incorporate automatic volume control to keep the level of strong and weak stations reasonably constant, and to avoid overloading by strong stations.

5. It should have a Beat Frequency Oscillator so that CW stations may be heard.

6. It should have a suitable audio amplifier to operate headphones or loudspeaker, or both.

7. It could have a signal strength meter to indicate changes in carrier level, although this is really a refinement.

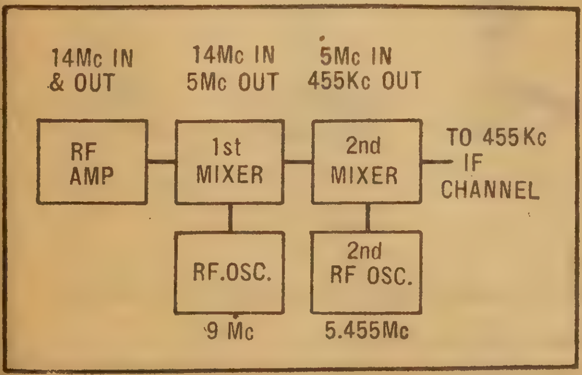
8. It may also have a crystal filter for extreme selectivity, particularly on CW stations.

THE SUPERHETERODYNE

The standard circuit used to achieve all these things with greatest efficiency is the superheterodyne. Straight tuned-radio-frequency receivers (TRF) are only used today for very simple sets.

What is a superheterodyne receiver?

A superheterodyne receiver is one in which the received signals are not amplified solely at their own frequency, but are "converted" to a much lower frequency at which higher gain, better selectivity, and lower noise level are possible.



Block diagram indicating changes for double superhet operation with typical frequencies for the two oscillators.

Conversion takes place in a "mixer" stage in which the incoming signal is mixed with the output of a local oscillator, whose frequency differs from that of the signal.

For example, a signal on 7000 Kc could be mixed with an oscillator output at 7455 Kc or 6545 Kc to produce an IF of 455 Kc which is the difference frequency between them.

Because the IF is a fixed frequency, the coupling coils (IF transformers) used in the amplifier are fix-tuned. The impedance of the tuned circuits is much greater than those at the signal frequency, and the gain is therefore higher because they present a higher load to match the high impedance output circuits of the IF amplifying valves. More efficient circuits also give greater selectivity, and as both grid and plate circuits are tuned, the coupling between them may be pre-determined to give the required degree of selectivity and gain.

SELECTIVITY

These are important reasons why the superhet is better than the TRF receiver for shortwave listening.

There is another reason why selectivity is better at the IF. When attempting to reject a station say 20 kc from a wanted signal at 14,000 kc (20 metre band) the difference between the two signals is only a small percentage of the operating frequency, and the task is extremely

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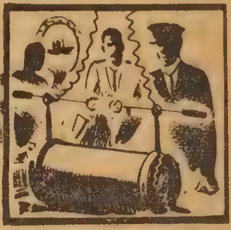

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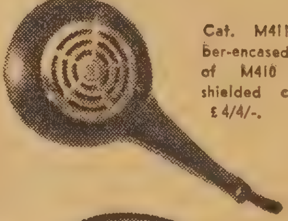

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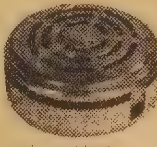
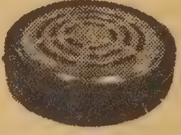


Cat. M410: As M409 but with highly plated R.F. shield, £1/18/6.



Cat. 409: For use as insert or microphone; plated front grill, £1/12/11.

Cat. 401: "Ball" type, stand mounted, crystal microphone, £6/16/1.

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Cat. B/80/1100/V: Swivel cage crystal type, stand mounted, with volume control, £8/19/5.

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difficult, if not impossible. But when converted to an IF of 455 Kc, the difference of 20 Kc is a very much larger percentage, and it would be a poor IF channel which could not reject an unwanted signal 20 Kc to the side.

If the IF were 50 Kc the task would be even simpler, as 20 Kc now represents a ratio to the IF of nearly 1-2.

The standard IF used for most short wave receivers is in the order of 455 kc which gives a good compromise between selectivity and gain. Lower IF's such as 85 and 50 Kc are sometimes used because the circuits are even more selective.

Multiple IF stages are not used merely to obtain extra gain, but rather for the added selectivity contributed by the extra tuned circuits, for better AVC control, better stability and/or some other circuit feature.

Sometimes extra IF transformers are included between stages, connected "back-to-back", to provide still further tuned circuits and selectivity. The net result is to sharpen the peak and reduce the skirt width of the IF response curves.

Occasionally the IF circuits are "stagger tuned" to flatten the peak of the curve while retaining the steep-sided skirt. Such receivers are generally required for receiving phone signals where a sharp peak would attenuate high frequency audio response and spoil intelligibility.

DOUBLE SUPERHET

If selectivity is obtained by using low IF's of 85 or 50 Kc, to mention only two possible frequencies, a double superheterodyne is sometimes used. This uses two frequency converters. The first converts to some frequency between about 2 and 5 Mc and the second to the lower frequency.

The purpose of the high first IF is to space the image so far from the signal frequency that the tuning circuits can easily reject it. Such a circuit is known by various names such as "double conversion", "double change" etc. Because the second oscillator tuning is fixed, it is often crystal controlled to reduce frequency drift.

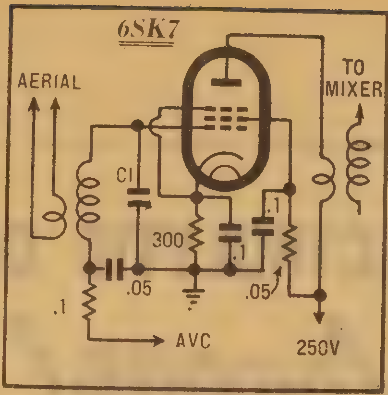
If extreme selectivity is not needed, the second IF may of course be 455 Kc as with the single conversion receiver.

It is important to remember, therefore, that all the advantages of the superheterodyne are due to this change of signal to lower frequencies and the more effective amplification and selectivity obtainable thereby.

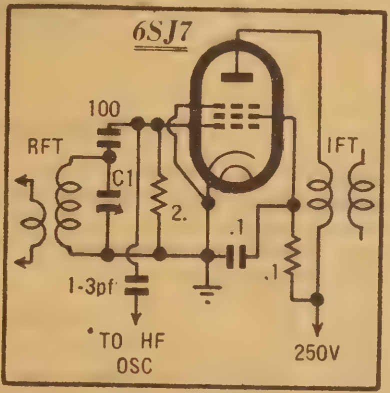
The IF channel contributes most of the gain and all the effective selectivity of the receiver. It does not normally contribute to the overall noise figure. This is virtually fixed at the first input grid of the receiver.

BLOCK DIAGRAMS

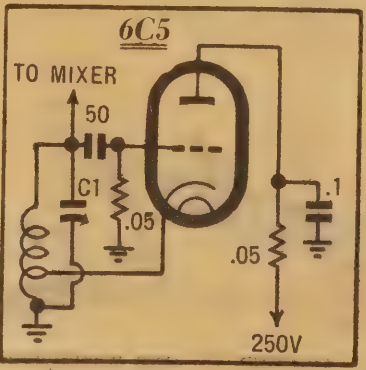
Following on these introductory remarks, let us now consider the block diagram, shown as Fig. 1, of a typical single conversion superhet. The units into which it divides are the RF amplifier, Mixer, HF, or Local Oscillator, two stages of IF amplification with crystal filter, detector, beat frequency oscillator, and audio amplifier. A power supply will, of course, be needed, but this is no different from that used with any other set. As a



A typical RF amplifier circuit, using a doublet aerial connection. This is similar to an IF amplifier circuit except that both input and output would be connected to IF transformers for such service. C1 is the tuning condenser.



A mixer circuit using grid leak bias provided by the oscillator, and control grid injection. Connection to the HF oscillator is through a very small capacitance, often obtained from two insulated wires twisted together. C1 is the tuning condenser.



A simple HF oscillator circuit suitable for connection to a grid injected mixer. A voltage regulator to stabilise HT voltage would be a good thing, particularly if a crystal filter is used, which would accentuate the effect of small frequency changes due to power supply voltage variations. C1 is the tuning condenser.

refinement, a voltage regulator may be used, particularly for the HF oscillator, but we won't worry about it here.

The function of the RF amplifier is to amplify the received signal and to pass it on to the mixer stage. The valve used should have a high gain at the signal frequency with a low equivalent noise figure. High valve noise at this point will degrade the signal-to-noise ratio of the set, and no subsequent amplification can improve it, as the noise from this stage will be amplified along with the signal.

Valve noise is due to electron movement within the valves. Although its contribution to the total noise of reception is not serious at 3.5 and 7 Mc, it becomes increasingly so at 14 and 28 Mc, and is the major limitation to sensitivity at higher frequencies.

The valve should have a comparatively high input resistance to avoid damping the first tuned circuit, thus spoiling selectivity and gain.

AERIAL MATCHING

The first tuned circuit provides an opportunity for matching the aerial feed-line, to the grid input impedance of the valve, an important matter in obtaining a good transfer of energy. The secondary coil should have as high a dynamic impedance and as high a Q as possible, the one to develop maximum input voltage to the grid, and the other to give best selectivity, two things which require somewhat different conditions. Heavy wire is needed to reduce resistance losses, and silver-plating is advised at very high frequencies for the same reason.

The selectivity will not be good enough to reduce the strength of other stations within the band, but it should be enough to reduce appreciably the double-spot or image which appears at twice the IF away from the required signal. For an IF of 455 this image will occur 910 kc away—nearly a megacycle, which is an appreciable percentage of the signal frequency, even at 14 Mc.

IMAGE RESPONSE

This image appears because the mixing of the signal and HF oscillator in the mixer stage produces two signals, one above and one below the oscillator frequency. Thus at 14 Mc with the oscillator on 14455 kc, the image will appear at 14,000 kc plus 910 kc, which is 14,910 kc. If a signal happens to operate on this image frequency, only the selectivity of the first tuned circuit will keep it out of the IF channel. As our example image falls in the 19 metre shortwave band, overseas shortwave stations could break through into 14 Mc reception even with a good RF stage.

By passing on an amplified signal, the RF stage allows the mixer to operate with but little contribution to set noise, for the noise figure of a mixer is never as good as that of an efficient amplifier. Because the IF amplifiers themselves produce negligible valve noise, it is obvious that the effective noise figure of the receiver is determined by the characteristics of the RF amplifier.

The function of the mixer is to accept the signal from the RF amplifier, together with the signal from the HF oscillator (455 kc higher or

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400	10	12	1⅝	⅞	24	300	350	2½	⅞
500	10	12	2	⅞	16	350	415	2	⅞
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lower in frequency), and to produce in the output circuit the largest possible signal at 455 Kc by the process of mixing.

This process is really intermodulation between the two frequencies and is only possible when there is a condition of rectification or nonlinearity in the mixer. Thus, all mixer valves and circuits are arranged for this condition to occur.

Conversion efficiency depends essentially not upon the strength of either signal, but upon the degree of intermodulation between them, provided that the oscillator voltage is at least equal to the amount required by the valvemaker's specifications for the mixer.

The input and oscillator signals can be brought together in various ways. In the pentagrid converters such as the 6A8, the triode oscillator section and the pentode mixer section use the same cathode stream and are thus coupled together. The triode-hexodes such as the 6J8 have separate oscillator and mixer sections in the same envelope and are coupled together through a special grid provided in the valve.

SEPARATE OSCILLATOR

A more flexible arrangement is to use a separate oscillator valve and couple it into an electrode of a pentode mixer. The suppressor is commonly used, and the net effect is similar to that of the triode hexodes.

High conversion efficiency is obtained by feeding a small amount of oscillator voltage into the control grid of a high transconductance pentode biased to cut-off. By using a grid leak for the pentode and allowing the oscillator input voltage to develop all its bias, a sensitive, self-regulating cicuit is obtained.

The use of a separate oscillator gives maximum control over the operating conditions of both valves, and is preferred, particularly at the higher frequencies.

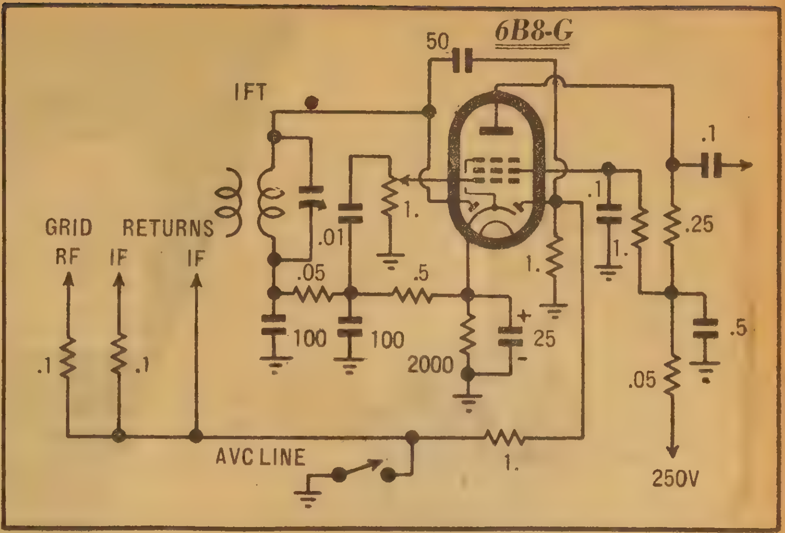
Pentode mixers are most commonly used because of their high gain and the good isolation between input and output circuits due to their internal screening. On higher frequencies triodes and even diodes are often used, because at these frequencies valve noise represents a higher proportion of total set noise, and both triodes and diodes have less valve noise than pentodes.

THE HF OSCILLATOR

The function of the HF oscillator is to provide sufficient voltage for the mixer for maximum conversion efficiency. It should be free from frequency drift, avoided by using mechanically rigid construction, high C/L ratio in the tuning circuit, and low operating voltages to avoid excess heat changes in the valve and its associated components. Voltage regulation also helps to avoid changes in oscillator frequency.

It should be as free from harmonics as possible, for these can load the converter valve with extra voltage that plays no part in useful conversion, and may create beat notes with unwanted signals or their harmonics.

Coupling to the mixer should be arranged so that there is the least possible interaction or "pulling" between the oscillator and converter input tuning circuits. This is most troublesome when the difference between these frequencies is a small percentage of the operating frequency.



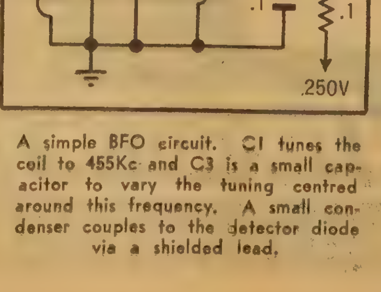
A standard circuit for a diode detector and pentode first audio stage, the second diode being used for AVC. The switch could be used to short circuit the AVC voltage when receiving CW. An RF gain control would then be necessary often wired in the cathode circuits of the controlled valves.

In practice, 455 Kc is satisfactory as high as 14 Mc, but on higher frequencies a higher IF is desirable to avoid pulling. Some compromise between all these general requirements is needed to obtain the best efficiency of both oscillator and mixer.

The function of the IF amplifiers is to amplify the signal from the converter sufficiently to operate the detector, and to provide the required degree of selectivity. Two stages are normally required to give enough gain for weak stations. High selectivity IF transformers of the type required generally have rather low gain, and this loss is made up by the extra stage.

Some care may be needed to prevent instability with two IF stages; and separately decoupled screen and plate circuits are commonly used.

A crystal filter is a device included as part of the IF channel to give extremely high selectivity. The crystal is of the normal quartz type ground to resonate exactly at the IF—in this case 455 kc. It is used to couple two tuned circuits in the IF amplifier.



A simple BFO circuit. C1 tunes the coil to 455Kc and C3 is a small capacitor to vary the tuning centred around this frequency. A small condenser couples to the detector diode via a shielded lead.

The high selectivity of the filter is due entirely to the fact that at resonance the crystal has an enormously high Q—the ratio of reactance to resistance.

The crystal may be regarded as a series resonant circuit with an extremely low RF resistance. At resonance, the capacitive and inductive reactances in the circuit balance out in the normal fashion, so that only the resistance is left as the total impedance to RF currents flowing in the circuit.

OFF RESONANCE

But to signals not exactly at resonance the circuit is reactive, and the total impedance to signals only a few cycles away is large enough to attenuate them very greatly as compared with those at resonance.

If we could make a tuned circuit with a Q as high as that of the crystal it would operate equally as well. In practice, however, this is not possible.

In a practical circuit, the capacitance of the crystal holder must be neutralised or "phased out" by a small variable condenser, otherwise it would allow some coupling around the crystal which would allow signals to leak through.

This is achieved by a simple type of balancing circuit generally in the secondary of an IF transformer.

The output circuit for the crystal is usually a single tuned coil in series with which is a variable resistor, which acts as a selectivity control.

For highest selectivity, the external circuits should have a low Q as compared with that of the crystal. By adding resistance in series with the output coil its Q is lowered, and circuit selectivity is highest. With the resistance value at a minimum, the output circuit Q is highest, and selectivity lessened. The operation of this selectivity control is often misunderstood, but its function is to vary the Q of the output coil.

The Q of the input coil, which is a transformer secondary, is designed to have a low Q also, so that the con-

POWER TRANSFORMERS

CODE NO.	Primary Volts	HTV ASIDE	HT mA	FILAMENTS
PF 185	240	150	30	6.3V/2A
PF 299	240	285	40	6.3V/2A 5V/2A
PF 300	240	325	40	6.3V/2A 5V/2A
PF 201	240	225	50	6.3V/2A
PF 152	230 240	285	125	6.3VCT/3A 6.3V/2A 5V/2A
PF 151	230 240	285	60	6.3V/2A 5V/2A

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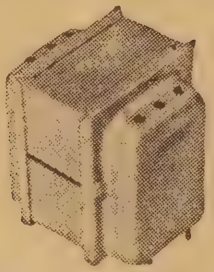

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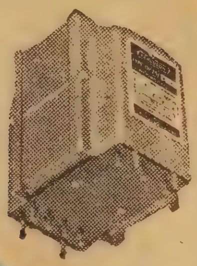

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VT 103	6	200	50	.005
VT 104	6	250	60	.005
VT 112	12	200	50	.005
VT 105	12	250	60	.005
VT 116	24	250	60	.005

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Engineered TODAY for TOMORROW'S requirements trolling circuit as far as selectivity is concerned is that of the crystal. This might have a Q as high as 50,000 as against a good coil Q of 200. When set for maximum selectivity the coil could be as low as 20.

Because of its high attenuation of side bands, the filter will greatly improve the signal-noise ratio of the receiver as compared with the "crystal out" position. This is an added help in reading weak signals.

The phasing condenser has another use, which is to give a "single signal" effect. As the circuit shows, it is actually in parallel with the crystal, and except at exact crystal resonance (where the crystal is purely resistive) will form a parallel resonant circuit with it. A parallel resonant circuit, as we know from fundamentals, has a very high impedance at its own resonance—it is a rejector circuit.

Now if we have an interfering signal say 1 kc away from the station we are receiving, and we adjust the phasing condenser so that this parallel resonant circuit is tuned to the interference, it will reject the interference, and prevent it from passing through the IF channel.

This slight mistuning of the phasing condenser is not enough to upset seriously it's neutralisation of the crystal holder capacitance as, because of the extreme circuit selectivity, interference is not usually experienced from stations more than 1 or 2 kc from the wanted signal. Naturally the single signal effect can only operate for one station at a time, but it does virtually remove the interfering carrier altogether.

In practice, there are numerous crystal filter circuits, and various elaborations in its use not dealt with here.

In its "sharp" position a crystal filter is useful only on CW signals, as its bandwidth is too narrow to pass intelligible speech. It can be increased by the selectivity control sufficiently to allow phone signals to be copied, and this is a useful feature under difficult conditions.

"SECOND" DETECTOR

The function of the demodulator or second detector is to separate the audio component of modulated signal from the carrier and deliver it to the audio amplifier channel.

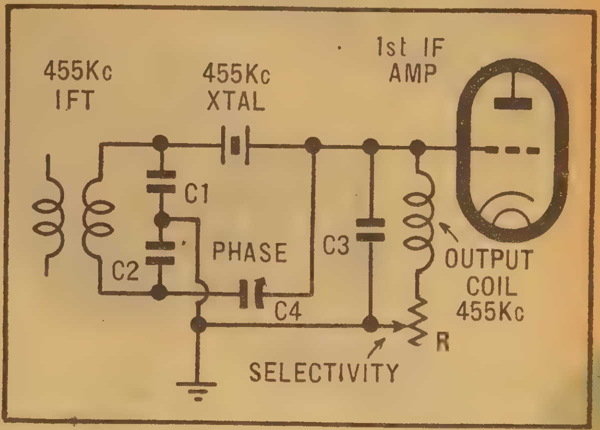
The normal method is to use a diode rectifier fed from the secondary of the last IF transformer, and to provide a resistive load across which the audio voltages are developed. The RF circuit is completed through a load bypass condenser too small in value to affect the audio component.

The process is the simple one of rectification in which the valve conducts in one direction but not the other.

A dc potential is built up across he diode load in the presence of a signal, its value being proportional o the RF voltage delivered to the rectifier, which in turn depends on he strength of the signal being received. The potential at the active nd of the diode load is negative, as his end is connected to the diode plate via the coil.

Because this potential varies with he strength of the signal it is often sed to provide automatic volume ontrol for the IF and RF amplifiers. The valves concerned are "variable-mu" types and the control voltage is pplied to the signal grid circuits via ecoupling networks to remove the udio component.

Some receivers use more elaborate AVC circuits. A common idea is to use the second diode of the detector-audio valve purely as an AVC rectifier, obtaining the necessary RF input through a condenser coupling either to the detector diode or to the plate of the last IF valve. Or again the last IF valve may be a diode pentode, and its diode used for AVC. It is more flexible to separate the functions of the detector and AVC diodes and this should be done if possible.



A simplified crystal filter circuit. C1 and C2 provide an electrical centre tap for the coil to allow neutralisation of crystal holder capacitance by C4. C3 tunes the output coil to resonance. R is the selectivity control.

The function of the AVC circuit is to adjust automatically the audio level of all signals to approximately the same amplitude thus avoiding constant alteration of the audio gain control.

The function of a signal strength meter is to give visual indication of the difference between carrier strengths of different stations.

A simple method is to connect a meter to measure the plate current of one or more valves connected to the AVC circuit. The plate current of the controlled valves varies in step with the variations in voltage applied to the input grids from the AVC line, being least when the grids are most negative.

By comparing the different degrees of meter movement, a comparison of signal strength can be obtained. The meter is arranged to read full scale with no signal, and the needle moves toward zero to indicate the presence of a carrier. The scale can be calibrated in db for easy reference.

AUDIO AMPLIFIER

There are other more flexible methods of connecting a signal strength meter such as a valve voltmeter circuit operated either from a voltage obtained from the AVC line, or from a separate valve amplifier connected to the plate circuit of the last IF stage.

The function of the audio amplifier is to receive audio voltages from the diode and to amplify them sufficiently to operate either headphones or loud speaker. Usually there is a voltage amplifier, a triode or a pentode, and a power output pentode or beam tube connected to the loudspeaker. A potentiometer is generally placed in the grid circuit of the voltage amplifier to operate as a gain control. Normal resistance coupling is common between these two stages and in general the circuit is the same as that used for any other receiver.

The function of the beat frequency oscillator is to provide a small RF voltage to the detector stage of the set which will beat with the incoming signal through the IF channel, and after detection provide an audible beat note to allow the make and break of morse code signals to be heard.

Its frequency is adjustable and is centred around the IF. The pitch of the note will depend on the difference frequency between the signal feeding through the IF channel and the frequency of the beat oscillator.

For instance a correctly tuned signal will come through the IF channel at 455 kc. If the BFO is tuned to 456 kc, a beat note of 1 kc will be heard, the difference between the two frequencies.

The beat note may be changed not only by varying the frequency of the BFO but also by altering the tuning of the set. This is because the signal through the IF channel is the result of the HF oscillator beating with the incoming carrier. Tuning the set alters the frequency of the HF oscillator, and hence the frequency of the IF signal.

The same effect would be produced if the received station were to slightly change its frequency, which is one reason why the transmitter frequency should be rigorously controlled.

The BFO tuned circuit is pre-set to 455 kc, and a small variable condenser wired across it used as a BFO note control.

AVC SWITCH

When receiving CW it is normal to switch out the AVC control, and adjust the strength of the received signal by a manual control which varies the bias of the RF and or IF valves. This ensures that the signal will not vary in strength with the AVC action as it is keyed, and gives a steady CW note.

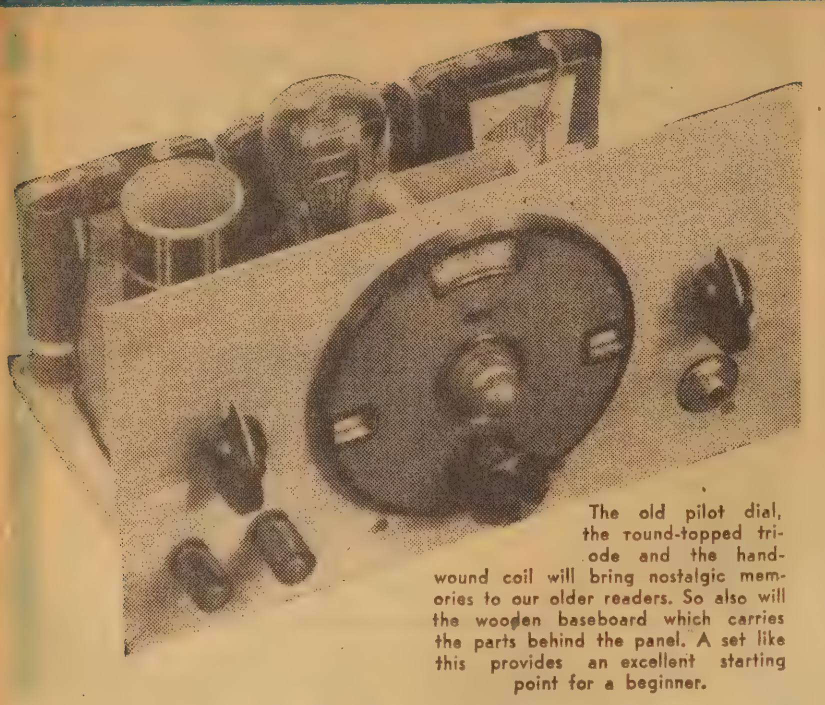
It is important to avoid radiation from the BFO circuit from being picked up in the IF channel by stray coupling, where it will be amplified and passed on to the detector. If this happens the whole IF and detector channel may be swamped with voltages from the BFO and unable to handle adequately those from the incoming signal.

The well shielded BFO should be mounted away from IF wiring and its small amount of coupling obtained via a shielded lead.

And so concludes our "walk through the receiver" in which we have tried to stress the fundamentals behind the operation of each section. We have tried, too, to keep the explanations of a general nature, but at the same time concise and accurate. From this point however, you should be able to start if you desire to study receiver design in more detail.

BUILDING A ONE-VALVE SET

You don't have to start off with a whole array of new parts to build a one valve set. If you can put your hand on a few oddments — even very ancient ones — there's a good chance that you'll save most of the cost. This article tells you how to go about it.



The old pilot dial, the round-topped triode and the hand-wound coil will bring nostalgic memories to our older readers. So also will the wooden baseboard which carries the parts behind the panel. A set like this provides an excellent starting point for a beginner.

JUST as a crystal set provides a good entry into radio construction, so can a one-valve set provide a cheap but effective introduction to the use of valves, batteries and the operation of more elaborate circuits.

Having once built up a successful one-valver, and learned some of the mysteries of tuning and regeneration, it usually isn't very difficult to go a step further and learn about audio stages, RF amplification, and so on.

Most of the small sets we have described in recent years have been designed on the assumption that the builder will be buying the necessary parts, identical or similar to those in the original model, and putting them together in precisely the same way.

EXACT DIAGRAMS

This approach makes it possible for us to prepare an exact circuit, give precise measurements, produce a wiring diagram and so on. It's all very nice except for one thing—that new parts cost money and this can be quite a problem to some of our younger readers.

That is why we have adopted exactly the opposite approach in this little set. We have deliberately assumed that you want to use up oddment parts and save money wherever you possibly can.

Actually this "junk-box" approach has a good deal to recommend it. By the time you have plagued your relatives for that old, discarded receiver and picked over oddment parts displays, you will have become fairly familiar with the appearance of radio components. The fact that you may have to make inquiries and look up data can only serve to increase your store of knowledge.

MUCH TO LEARN

And, of course, if the set doesn't work when you've finished it, there's a good deal to be learned while you're trying to find out why. But let's get on with the story:

The first and obvious requirement for the set is a valve—and the means to supply it with power! Whatever valve you choose, it will need a "low-tension" or "A—supply" for its filament and a "high-tension" or "B— supply" for its plate.

Most domestic sets these days obtain their power from the mains, via a power transformer, rectifier and filter system. While very convenient for a large receiver, such a system is unnecessarily complex for the kind of set we have in mind.

Provided one can locate a valve which does not require too much voltage and current for its operation, it can be powered quite conveniently from a few relatively cheap torch batteries. Your first problem, then, is to find a suitable valve.

The best choice is obviously one of the many types intended for use in battery-powered portable sets. These have been made with the ordinary octal-based "—GT" construction, on American "Loktal" bases and, of course, in the modern miniature all-glass construction.

RECENT EXAMPLE

You may remember that, when choosing a valve for our recent "Loop-Stick One", we selected the 1T4 as being the most suitable but it is by no means the only one you can use.

Most of the dry-battery valves, as you will discover from valve charts, have filaments which operate at 1.4 volts and a current of between .05 and 0.1 amp.

A single valve of this type can be operated quite conveniently from a single large torch cell—or any other type of cell rated to deliver 1.5 volts.

One or two of these valves, like the 3S4 and 3V4, have a tapped filament which can be connected with the two halves in parallel across 1.5 volts, or with the two halves in series across 3.0 volts. This latter arrangement allows then to operate very conveniently from a 3-volt cycle battery.

The only other valves worthy of consideration are the older 2.0-volt series, originally intended for use in sets taking their filament power from an accumulator. Many of these draw between .06 and 0.12 amp, though a few run up to 0.24 amp, which is rather on the high side for small cells.

The 2.0-volt valves will occasionally work reasonably well with only 1.5 volts applied to their filaments, as from a single dry cell. It is certainly worth a trial.

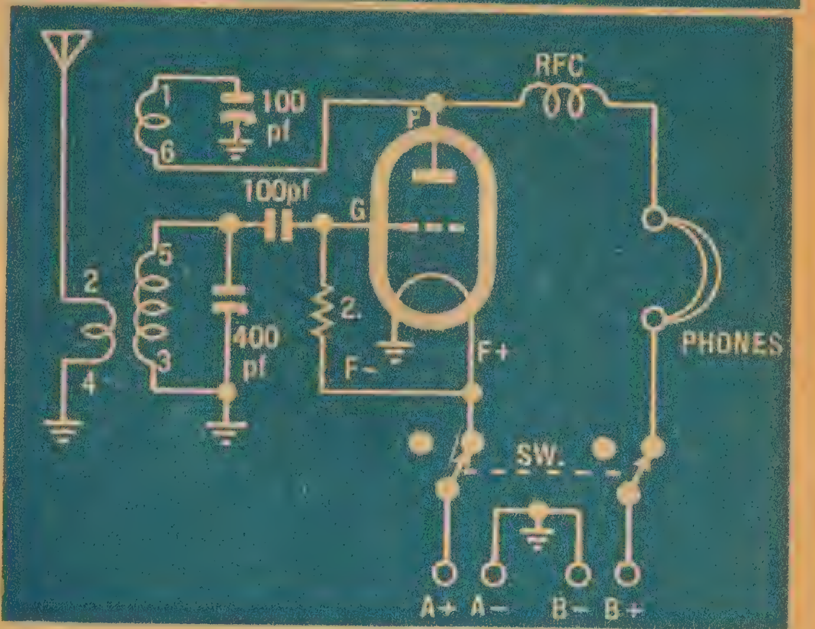
Alternatively, a 2.0-volt filament can be operated from a 3.0-volt source, such as a cycle lamp battery (two cells in series), provided a suitable dropping resistor is connected between the positive lug on the battery and the positive filament lead.

RESISTOR VALUES

For a valve drawing .06 amp, this resistor would work out at about 13 ohms. It would be 9 to 10 ohms for a 0.1 amp filament, 7 to 8 ohms for a 0.12 amp filament and half this figure again for one drawing 0.24 amp.

Valves requiring 5 or 6 volts for their filaments or intended for use in mains receivers are hardly worth worrying about, unless you have

THE BASIC ONE-VALVE CIRCUIT



The circuit is traditional in every respect. We have deliberately omitted the valve type number and the operating voltages because these will vary according to the bits and pieces you have on hand. The requirements are explained in the article.

access to a discarded car accumulator and a means to keep it charged.

Anyhow, having selected a valve with a suitable filament rating, the next question concerns the number of electrodes and pins that it may have. There are triodes, pentodes, beam power valves, converters and so on in a seemingly endless array.

We have tried to make things easy in our circuit by implying that it requires only a triode detector—filament, control grid and plate.

If the valve you locate happens to be a triode, you won't have any further worry on this score. You will simply look up the valve charts and discover how the pins connect to these various electrodes.

If your valve happens to be a diode-triode, you will simply use the filament, grid and plate pins and neglect the diode connections altogether.

PENTODE VALVES

If the valve you get happens to be a pentode (or beam tetrode) it will have a screen pin, in addition to those for the filament, grid and plate. The screen can either be linked across to the plate or else bridged to the B-plus connection.

Even converter valves can be connected up to function as triodes, though we haven't actually tried them in this present little set. Oscillator anode (if any), screen and plate can be tied together and the signal fed to the oscillator grid. The normal signal grid can either be earthed or tied to oscillator grid, whichever scheme works the best.

And which valve did we use? Well, we resisted the temptation to extract a 1.4 volt type from our normal stock and went searching instead among the dusty oddments. We came up with a couple of 2-volt types — a 1A4-P pentode and an old 30 triode. This latter valve was in position when the set was photographed.

It has very modest characteristics and will be out-performed by most of the more modern types. Even so, it serves the purpose very nicely.

We tried running the 30 from a single 1.5-volt cell and it worked in a fashion, remembering that the plate supply voltage was also very low. It did a good deal better when the filament was supplied from a 3-volt cycle battery through a series-dropping resistor.

Actually the plate supply voltage has a big effect on the performance of the receiver, higher voltages allowing the valve to operate more efficiently and to deliver more power o the headphones.

BATTERY PROBLEMS

The ideal is undoubtedly a 45 or 67½-volt radio B-battery, but these re rather expensive, if you have to uy them new. However, if you can cquire a run-down battery from a riend or from your local radio dealer, will run your 1-valve set long after has ceased to be of any use in a egular portable.

The dealer would only throw it ut, anyway.

As you can see from the photograph, we used three 4.5-volt flat orch batteries, connected in series o give 13.5 volts. This is just about he minimum worthwhile voltage for n old-style valve. We measured the urrent drain and found that it would arely move the pointer on the 1-milliamp range. We reckoned it to be about 12 microamps, or one-thousandth part of the drain of a normal portable!

Having settled the matter of the valve and the batteries, several other parts have to be selected before you can lay them all out on the panel and baseboard.

The first of these is the variable tuning capacitor, which should have a maximum value of from .0004 to .0005 mfd. It can be anything from a modern miniature type to a relic extracted from an ancient battery set.

Assuming that the capacitance is of the right order the other main point is to see that the plates move smoothly and do not touch at any point in their travel. If not satisfactory in this respect, the capacitor should be cleaned up and adjusted before mounting in the set.

You will also need some kind of a dial, preferably a vernier type, because the tuning can be critical on weak stations. These have been made in a variety of styles for mounting in front or behind the panel. It is just a matter of making sure that the dial will suit your proposed layout and that it can be mated to the spindle of the tuning capacitor.

PARTS LIST

1 Baseboard 7¾ x 4½in (approx.)
1 Aluminium panel 8¾ x 5½in (approx.)
1 Dial, preferably slow motion
1 Phone jack or substitute
2 Terminals
1 Off-on switch, either single or double pole
1 Tuning capacitor (.0004 mfd. approx.)
1 Reaction control capacitor (.0001 mfd. or higher)
1 Valve (see text) and socket to suit
1 RF choke
1 2 meg. resistor
1 .0001 mfd. mica capacitor
1 Coil former and wire to suit (see text)
1 Pr. of headphones, preferably high impedance
Batteries as required, hook-up wire, solder, screws &c.

The smaller variable capacitor is for "reaction" control, about which we will have more to say later. It, too, should operate smoothly and have a capacitance value of at least .0001 mfd. It could actually go as high as .00025 mfd, though capacitors of this order will be more critical to adjust and will also take up more space.

An ordinary knob is sufficient to operate this capacitor.

The only other control is an "off-on" switch to break the filament circuit when the set is not in use. A simple toggle or single-pole switch is sufficient for this purpose, the drain on the B-supply ceasing automatically when the filament circuit is broken.

SECOND CIRCUIT

If the switch you choose happens to have a second set of contacts, as did the one we used, they can be wired to break the B-supply, but it is not at all important.

For the rest, you will need a couple of terminals for the aerial and earth connections and a phone jack or two more terminals for the phone connections.

The RF choke can be almost anything that goes by that name, while the .0001 mfd capacitor and 2-meg resistor are standard small components. Actually these values aren't at all critical and the capacitor can be as high as .0005 and the resistor anything from 0.5 to 5 meg. in most cases.

Finally, there is the coil which can be wound on a former anything between 1½in and 2in in diameter and

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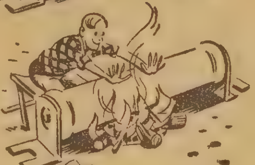

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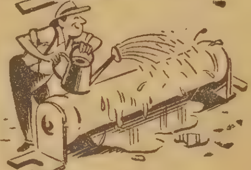

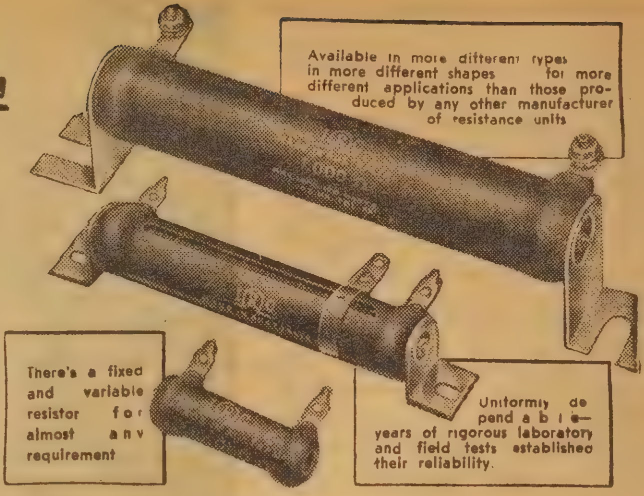

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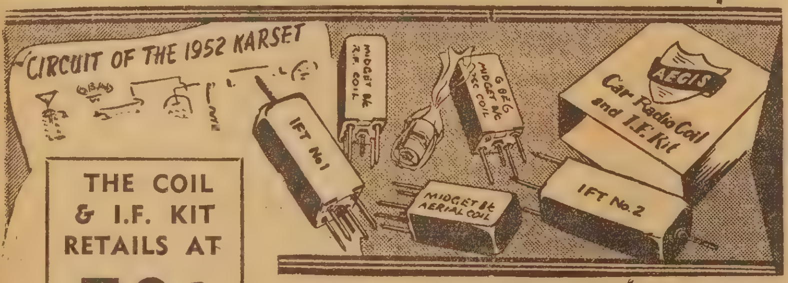

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up to about 4in long. We will have more to say about this later, but you will need to know what size the component is going to be before the set can be laid out.

Assuming then that you have managed to get together all the necessary parts, the next job is to arrange them into a suitable layout The photographs and diagram show how we did it and your own layout can probably be arranged along similar lines.

Normally the main tuning capacitor will go in the centre (though it doesn't have to) allowing enough clearance for the plates to swing fully open.

The reaction capacitor will normally mount alongside it, also with enough clearance for its plates. The switch goes on the other side to balance the appearance of the panel.

FRONT PANEL

For the components we had to use, the panel size worked out at about 8¾ x 5¼ in, leaving enough clearance all round for the set to slide into a box and the panel to screw against the front edges.

We do suggest, however, that you follow our lead and use a metal panel, ideally a piece of 16 or 18 gauge aluminium. If this presents any problems, you should use at the very least, a layer of tinplate behind a non-metal panel.

Connected to the earth system of the set, a metal panel largely eliminates so-called "hand-capacity" effects, whereby moving the hands in front of the receiver upsets critical reaction and tuning adjustments. Old-timers will know all about this one!

Actually, it's a good idea to determine the approximate panel size first of all, sketching it on a scrap of paper and placing the dial and knobs, &c., in their proposed positions. You'll have to look at the panel quite a lot when the set is finished and, it's worth while trying to avoid an oddly placed assortment of knobs and things, before you start drilling holes.

Behind the panel, it's a very simple matter to mount the rest of the parts of a scrap of deal or heavy plywood, following the traditional "breadboard" method of assembly. Our baseboard turned out to be 7¾ x 4½in, which was large enough to carry the batteries, as well as the actual receiver components.

There's no point in having the batteries hanging loosely at the end of wires if you don't have to!

Having thus decided on the layout, cut the panel and baseboard to size and fix them together with fine woodscrews.

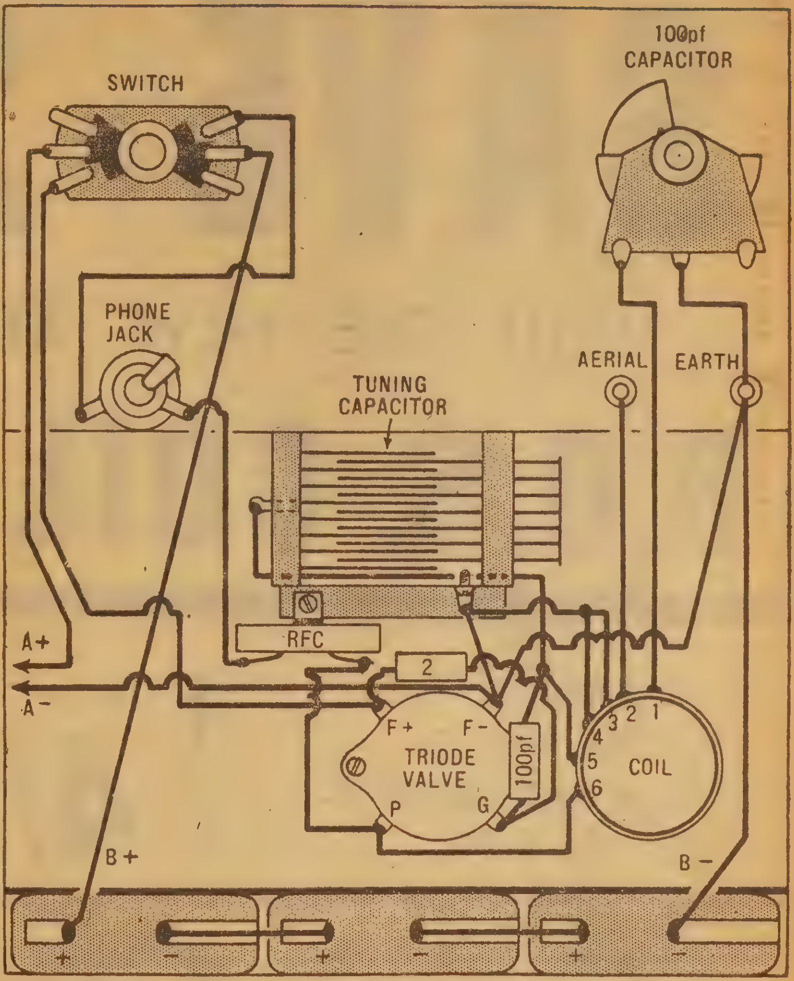
"EARTH" CIRCUITS

The main tuning capacitor can hen be mounted in position, renembering that, since the moving lates are earthed, they and the rame of the capacitor can make ontact with the panel. The fixed lates must, of course, remain comletely insulated.

Similarly, the moving plates and pindle of the reaction capacitor can e "earthed" to the panel, making ure that the fixed plates remain ully insulated.

The "earth" terminal can mount traight on to the panel, but the

HOW ONE-VALVE SET IS WIRED



Here is the wiring diagram prepared from our original receiver. The parts may be of different size from those you choose but due allowance can be made for this. Note particularly that the valve connections are as seen from above, due to the baseboard construction. Valve charts usually show the connections when looking on the pins so that care will be necessary to avoid confusion.

"aerial" terminal must be insulated in a suitable fashion. Modern terminals have a little flange moulded into them which allows them to pass centrally through an over-sized hole, making it all very easy. Most of the older types have to be insulated with a set of small bakelite washers.

The same applies to the switch, which you will have to check for yourself. In most modern switches, both toggle and rotary, the operating part of the switch is insulated from the contacts and the whole thing can, therefore, be mounted on to a metal panel. With some of the older styles, insulating washers have to be used.

Finally, the phone jack operates entirely in the plate circuit of the valve and neither side is "earthy" Unless you happen to have an ex-disposals jack with a bakelite body, it is almost certain that your jack will have to be insulated from the metal panel.

Any short between the panel and phone jack circuits will short the B-batteries either directly or through the phones.

All this may sound a trifle laborious, but it isn't really hard work, and, it's very valuable experience in handling radio components.

Behind the panel, a good deal of your "earth wiring" will have been completed by the time you have finished the assembly. In other words, the earth terminal, the frame of the tuning capacitor and the frame of the reaction capacitor will all have been connected together, as required by the circuit.

Any other earth returns can be made to the most convenient point on this assembly.

VALVE SOCKET

- The next obvious move is to get hold of your valve socket and start working out the connections to it.

We were lucky enough to find an old-style 4-pin socket intended for screwing to a wooden baseboard. You may be equally lucky.

SAVE 25/-

WITH THE NEW STANDARD

R.C.S. COIL KIT!

B/c Aerial
B/c Osc. 455 KC
2 Intermediates 455 KC
1st & 2nd

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4/5 ***valve***

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..... **Type Z 122**

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Whistle Filter 10 KC
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..... **Type Z 124**

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One point we would stress, however: Before you attempt to use the socket, scrape and tin the lugs. Many old style sockets will not take solder at all well. While on the job, it is also just as well to check the tension on the contacts. We had partly to dismantle our set because of a bad connection to the valve's plate pin.

In checking the valve connections, remember that most valve data charts give the pin connections as seen from underneath the socket, looking on to the valve pins. They do this because most sockets these days are wired from beneath a metal chassis. When wired from above, the pin numbers run in a clockwise rather than an anti-clockwise direction.

If using an octal or a 7-pin miniature valve, it is almost certain that you will have to use a wafer socket and devise some means of holding it clear of the surface of the baseboard.

SOCKET CONNECTIONS

In such a case, the necessary connections can be made to the filament, plate and grid pin, viewed from underneath as in the valve data charts. By using separately colored wires,the leads can then be identified easily when you have to connect them into circuit.

From this point on, it is largely a matter of following the circuit and wiring diagram to interconnect the various components.

To do this, you will need a few feet of hook-up wire or of tinned copper wire with spaghetti tubing just large enough to slip over it. We must assume that you know enough about soldering to get by. If you don't you'll soon learn, even if it is the hard way!

As we have already implied, the batteries can be mounted on the chassis and wired directly into circuit. They won't need to be changed very frequently—not the B batteries anyway.

The filament battery could conceivably be mounted in some kind of a clip arrangement, which would allow for its replacement at more frequent intervals. However, you can please yourself on this point.

To mount the torch batteries constituting the B supply, we simply mounted an angle bracket to the chassis, 6½in long by about 1¼ in high. We then cut a scrap of 3-ply to the same size, drilling two holes through both to take a couple of long 1-8th in bolts just far enough apart to clear the centre battery. Tightening the bolts forms a simple clamp sufficient to hold all three batteries in place.

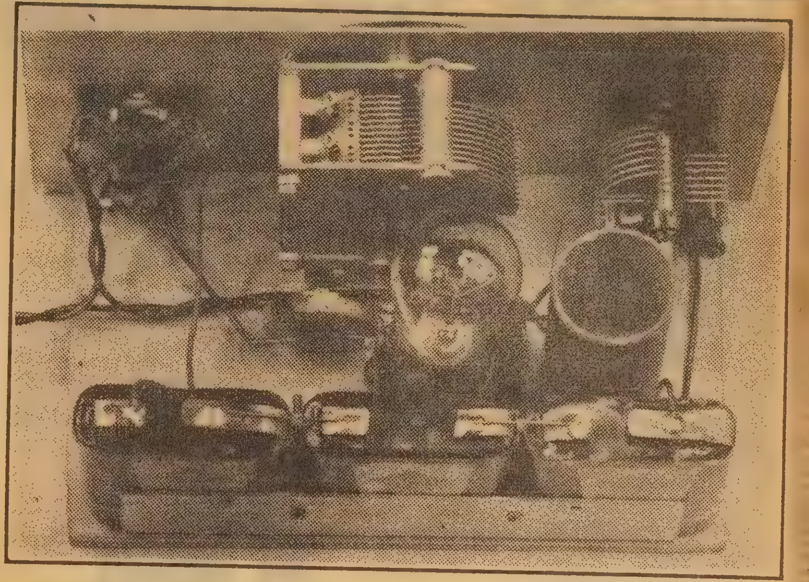
TUNING COIL

Finally, there is the matter of the coil, which we have left to last because its construction is the most tricky job and also the key to smooth operation of the finished set.

Most coil data are given in the basis that you MUST have a former of specified dimensions and MUST use o many turns of such and such a gauge wire.

That is certainly a good way to nsure duplication of the original oil but it does not help very much hose who want to use materials lready on hand. Our specifications, his time, will aim to be a little more flexible.

A TYPICAL SET FROM ODD PARTS

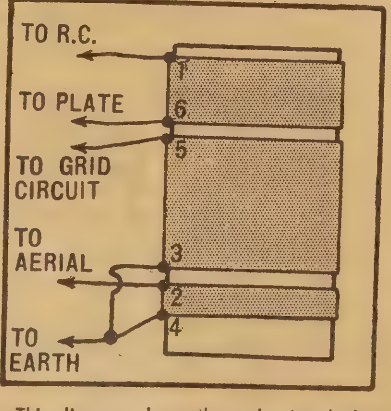


A rear view of the set, showing the three torch batteries clamped in position, providing the plate supply. Another torch or cycle battery to operate the filament circuit can mount in front of these again and alongside the RF choke.

We started off with a piece of ordinary cardboard mailing tube as sold by newsagents, measuring 1 3-8in in diameter. We then cut a small bobbin from thick plywood, using a fretsaw, which was a snug fit inside the tube. This bobbin was screwed to the baseboard in a position where the coil former would push over it and remain firm. This dispelled any worries about mounting the finished coil.

We knew that the coil would require three windings in all — an aerial or "primary", the main tuned "grid" winding and the "reaction" winding. We reckoned to put them on in that order, starting from the bottom up. All windings had to go on in the same direction—a most important point.

Leaving about half an inch clear at the bottom of the former, we pushed a couple of holes through it with a large needle and threaded the end of our winding wire through the holes a couple of times, leaving about four inches of wire hanging loose.



This diagram shows the order in which the connections are made to the home wound coil. The numbers correspond with similar numbers in the circuit and wiring diagram. All coils should be wound in the same direction.

We then wound on 15 turns, pushed another couple of holes through the former, cut the wire, threaded it through a couple of times and left a second free end for connection into circuit.

We then made a new set of holes about 1-8in away from this first winding, threaded the wire through again and started the main grid winding.

GRID WINDING

For this winding, we put on 100 turns, which left about an inch of former at the top for the reaction winding.

This latter was wound with a finer gauge wire to about 70 turns, occupying practically all the remaining former.

Yes, but what kind of wire? What gauges? What kind of covering?

Well, we used 28 B & S enamel for the aerial and grid windings because it gave a coil of suitable dimensions. (SWG gauge 29 is practically the same thing.) You could use the same wire or a gauge or so finer without introducing any serious bother. Thicker wire will increase the length of the coil, make it rather unwieldy and necessitate using a much longer piece of former.

The same remark applies about using cotton-covered wire. Unless it winds nearly 70 turns per inch, it will inevitably make the coil too long. Something like 30-gauge silk covered would do, however.

What about using formers other than 1 3-8in as specified? Well, decreasing the size of the former means increasing the number of turns in roughly the same ratio. Therefore, 100 turns on 1 3-8in is equal to about 110 on 1¼in.

Conversely 92 turns would be

(Continued on Page 49)

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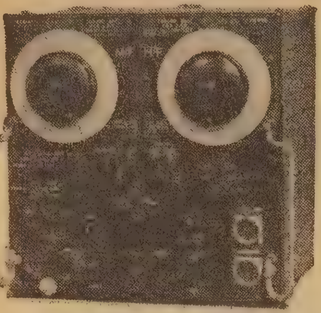

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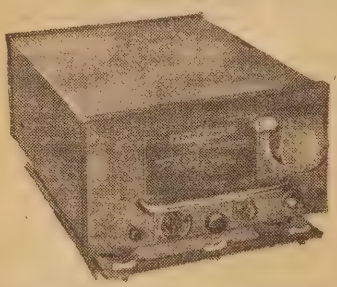

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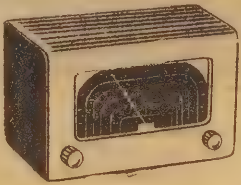

ONE-VALVE KIT SET

for the Learner

Although this little set is quickly and simply built, it looks like a factory-built job. The wooden cabinet is covered with burgundy leatherette and the dial has all Australian stations marked in different colours. Parts are mounted on a wooden baseboard and anyone can build it if they can use a soldering iron. Circuit diagrams, wire, solder, etc., supplied. Price for complete kit of parts, including Valve, Headphones and Batteries at normal price is £8/5/-

Our price is £5/19/6
Weight 9lb 2oz.

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SOME USES FOR ELECTROMETERS

Many tests of radio and electronic equipment involve the measurement of minute voltages and currents and resistance values mounting to millions of megohms. This article by Aerovox engineers describes the modern electrometer, which is used for such tests and which represents an extension of the principles behind the vacuum-tube voltmeter.

THE electrometer is an invaluable instrument in physics and electrical engineering when its potentialities and peculiarities are understood. It finds use both in research and testing.

In one form or another, the electromechanical type of electrometer has been used in experimental physics for many years. Its familiar types include quadrant, binant and fiber.

Electrometers differ from electroscopes, to which they bear some resemblance, in that the electroscope requires only the potential under test for its deflection, while the electrometer must be supplied with an auxiliary potential as well.

The ancient gold-leaf electroscope and the modern electrostatic voltmeter are examples of the single-potential instrument.

The chief advantage of the electrometer is its extremely high input resistance. This characteristic enables the measurement of small currents. It also permits the measurement of voltages under conditions requiring only the minutest current drain. Small currents, such as the 10 to the minus 10 microampere levels produced in gas ionised by radioactivity, has been measured with electrometers.

VERY DELICATE

Electromechanical electrometers, being delicate instruments, are sensitive to vibration, shock, and to some extent to field effects and to air currents. They accordingly give their best performance in the laboratory under skilled handling.

The modern vacuum-tube type of electrometer often can be used in environments unfavorable to electro-mechanical type.

It utilises a more rugged d'Arsonval type of indicating meter, instead of the delicate galvanometer, and is adapted readily to field use. Moreover, the vacuum-tube type allows the measurement of current by the steady-deflection method, rather than the rate-of-drift method required by other electrometers.

In principle and in general configuration, the vacuum-tube electrometer resembles the well-known DC vacuum-tube voltmeter. The main difference is the extremely high input resistance of the former.

VT voltmeters, for example, have input resistance commonly in the range 10 to 20 megohms. The input resistance of an electrometer can be of the order of ten thousand million megohms.

Figure 2 shows a typical skeleton circuit of a vacuum-tube electrometer. The circuit is battery-operated, V1 is the filament battery, V2 plate battery, and V3 a bucking battery for zero setting. The "high" input terminal, X1, is provided with a guard ring. Terminal X2 may be grounded to X3, or floated, as test conditions require.

TYPE	MANUFACTURER	Filament Voltage	Filament Current	Plate Voltage	Plate Current	Grid #1 Voltage	Grid #2 Voltage	Grid #1 Current	Grid #2 Current	Plate Resistance	Trans-Conductance
VW41	Victoreen	1.5	0.015	6.0	10	----	1.0	250	$<10^{-8}$	125K	10
FP-54	Gen'l. Electric	2.5	0.09	6.0	60	4.0	4.0	10^{-9}	----	45 K	20 ②
CK571AX ①	Raytheon	1.25	0.01	10.5	200	-3.0	----	2×10^{-7}	----	----	160
CK5697	Raytheon	0.625	0.02	12	220	-3.0	----	5×10^{-7}	----	----	135
CK5889	Raytheon	1.25	0.0075	12	5.0	-2.0	4.5	3×10^{-9}	5.0	18×10^{6}	14
D-96475	Western Electric	1.0	0.27	4.0	85	3.0	4.0	10^{-9}		25K	40 ②
		VOLTS	AMP	VOLTS	μa	VOLTS	VOLTS	μa	μa	OHMS	μMHOS

① Data for triode-connected pentode

② Microamperes-per-volt

CHARACTERISTICS OF ELECTROMETER TUBES

FIGURE 1

The indicating DC microammeter is connected in the "cathode" return circuit in series with resistor R3, which is kept high in value for maximum degeneration. Stability and linearity are enhanced by this degeneration. The instrument is set to zero by means of potentiometer R2 and the bucking battery, V3. Switches S1 and S2 disconnect the batteries when the electrometer is not in use.

No plate-battery switch is required since disabling the filament circuit removes plate current.

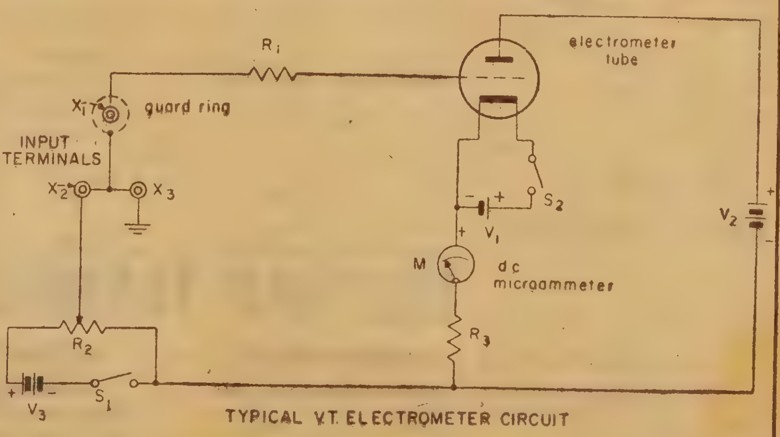
A standard radio tube would be unsatisfactory in this circuit, since its input (grid-filament) resistance would be too low for electrometer use. Maximum current amplification demands that input resistance be high.

Tube insulation usually is good, but internal charges reach the grid, increasing conductance. Special electrometer tubes have good evacuation and operate at low plate voltage to prevent ionisation of whatever residual gas is present. They are operated also at low filament voltage and current, and some types are provided with an internal shield grid to isolate the control grid from positive ions from the filament.

SECOND GRID

In some instruments, the second grid is used for the test-voltage input. In the electrometer, the tube is darkened to prevent spurious photoelectric effects, its envelope is washed carefully with a grease-removing solvent, and the outer surface of the envelope may be coated with a high-quality insulating material for additional protection against contamination from accidental touching or from the atmosphere.

Figure 1 shows the characteristics of some electrometer tubes. The electrometer usually is provided with several ranges. Range switching is



TYPICAL V.T. ELECTROMETER CIRCUIT

FIGURE 2

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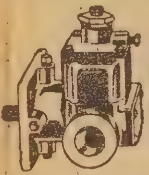

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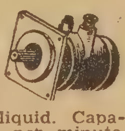

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2X2		15	0
5V4		12	6
5Z4		11	6
6A8G		15	0
6AC7		15	0
6AG7		15	0
6C8G		12	6
6F6G		15	0
6H6		12	6
6J5		12	6
6J7G		12	6
6K7		12	6
6L7G		15	0
6SH7		7	6
6SJ7		12	6
6SK7		12	6
6SL7GT		12	6
6SN7		12	6
6SS7		12	6
6U7		12	6
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1625	£1	0	0
1629		12	6
KTZ.41		5	0

Germanium Diodes

7/6 each

Postage & Packing, 1/-.

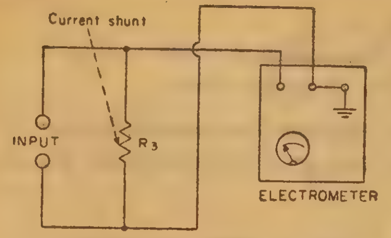
Suitable for use as mentioned in Book 115 — Constructors' Handbook of Germanium Circuits — priced at 3/9.

24V. Motor & Pump

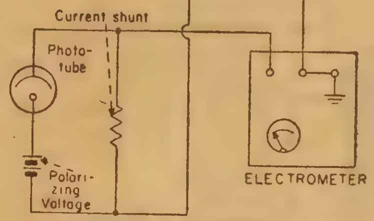
Motor will operate from 24 or 32 volt AC or DC. Capacity of pump 250 gallons per hour. Compelte wtih long reach tube. Will pump any liquid from drums, etc. Brand new.

£5/-/-

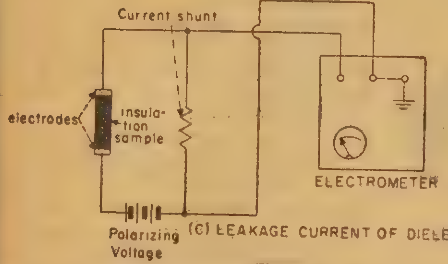
(Available from Sydney Branch only.)


Current shunt
INPUT
R3
ELECTROMETER

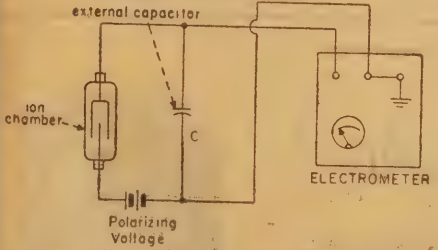
(A) GENERALIZED CURRENT CONNECTION


Current shunt
Photo-tube
Polarizing Voltage
ELECTROMETER

(B) MEASUREMENT OF PHOTOTUBE DARK CURRENT


Current shunt
electrodes
insulation sample
ELECTROMETER
Polarizing Voltage

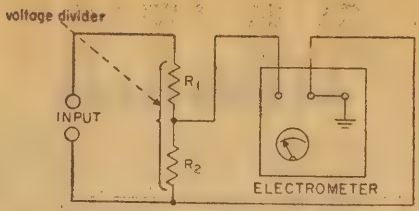
(C) LEAKAGE CURRENT OF DIELECTRICS


external capacitor
ion chamber
C
ELECTROMETER
Polarizing Voltage

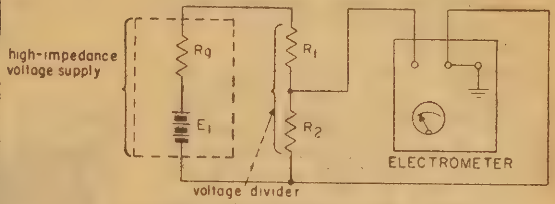
(D) ION CHAMBER CURRENT IN RADIOACTIVITY TESTS

CURRENT-MEASUREMENT CIRCUITS

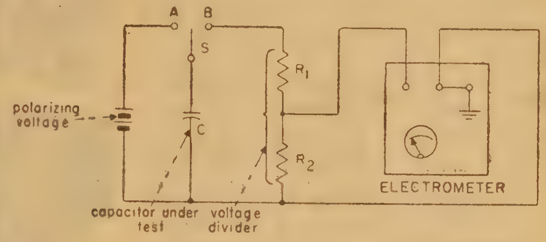
FIGURE 3


voltage divider
INPUT
R1
R2
ELECTROMETER

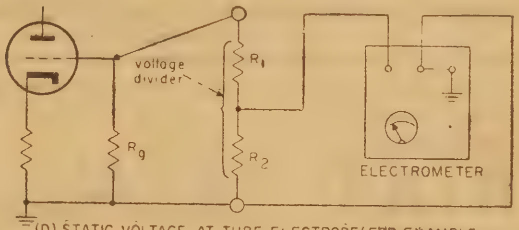
(A) GENERALIZED VOLTAGE CONNECTION.


high-impedance voltage supply
Rg
E1
R1
R2
ELECTROMETER
voltage divider

(B) OPEN-CIRCUIT VOLTAGE OF HIGH-IMPEDANCE SOURCE


A
B
S
polarizing voltage
C
R1
R2
ELECTROMETER
capacitor under test
voltage divider

(C) CHARGED VOLTAGE AND LEAKAGE OF CAPACITOR


voltage divider
R1
R2
Rg
ELECTROMETER

(D) STATIC VOLTAGE AT TUBE ELECTRODE (FOR EXAMPLE, CONTROL GRID)

VOLTAGE-MEASUREMENT CIRCUITS

FIGURE 4

ccomplished by changing simultaneusly the values of voltages, V1, V2 and sometimes V3), and resistor R3. portion of R3 is made adjustable or range calibration.

The scale of meter M may be calirated to read directly in volts. Restor R1 is a current-limiting comonent, the purpose of which is to mit tube input current when exessive signal voltages are applied. xcellent insulation is employed for e input terminals, range switch, ro-set potentiometer, and limiting sistor. These precautions are necesry to prevent a low-resistance unt of the high input resistance the tube.

OW CAPACITANCE

Input capacitance of the instruent is very low, being less than mmfd. in commercial vacuumbe electrometers. Because of the gh input resistance and the conquent long time constant, this pacitance can retain a charge and use the meter to remain deflected ter a test voltage has been removed om the input terminals.

For example, a time constant of 7.5 seconds would be obtained with an electrometer having 7.5 micro-microfarads input capacitance and one million megohms input resistance.

Because of the low electrometer-tube currents, the plate and filament batteries can be expected to give long life, requiring infrequent replacement and causing little concern if the instrument inadvertently is left switched-on during brief idle periods.

Typical electrometer applications are discussed in the following paragraphs.

An external shunt resistor may be used to convert the electrometer into a current meter in the same manner that such a resistor is used with a DC vacuum-tube voltmeter. (See Figure 3 (A).

However, the difference is that the electrometer shunt may have a high resistance value, often many megohms.

In this way, the electrometer may be converted into a micro-microammeter. If the scale of the electrometer is graduated in volts, the unknown current value I (in microamperes) equals E/R where E is the electrometer deflection in volts, and R is the shunt-resistor value in megohms. Figure 3 (B) shows how the electrometer and an external shunt conveniently can be used to measure the dark current of a phototube.

POLARISATION

The tube is supplied with its normal polarising voltage, and the resulting leakage current sets up a voltage drop across the high-resistance current shunt. This drop then deflects the meter and is converted into current units as explained in the preceding paragraph.

The tiny leakage current of an insulation sample, especially at low test voltages, may be checked with the arrangement shown in Figure 3 (C).

This circuit is analogous to the preceding one in that a DC test voltage is supplied to the sample in series with a high-resistance current shunt. The polarising voltage will be of whatever value at which the leakage data are required. This arrangement may be employed also for checking the leakage current of high-quality non-electrolytic capacitors, *New*

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Unique stability, with less than 0.1% total distortion. Higher order distortion, 0.03%.

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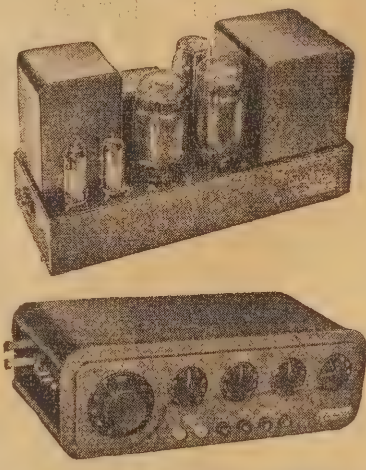

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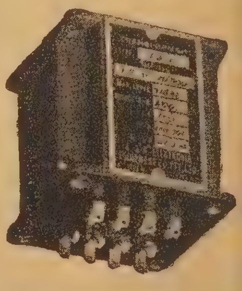

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OUTPUT TRANSFORMERS

* Response Includes Correction due to Negative Feedback ** For use With Rola 12-OX Speaker.

TYPE AND MOUNTING	IMPEDANCE-OHMS		FREQ. RESPONSE		RATING WATTS	TYPICAL APPLICATION
	PRIMARY	SECONDARY	DB+—	CPS		
894-23	500	2, 3.7, 8, 12.5	2	50-10,000	5	LINE TO VOICE COIL
900-22	2500 5000	2, 3.7, 8, 12.5, 15	1	*40-15,000	15	SINGLE 807, EL34, ETC, TO V
896-9	8000 10,000	2, 3.7, 8, 12.5, 15	1	30-15,000	15	PP6V6G's A OR AB1 TO VC
897-9	8000 10,000	100, 125, 166, 250, 500	1	30-15,000	15	PP6V6G's A OR AB1 TO LINE
763-9	3000 5000	2, 3.7, 8, 12.5, 15	1	40-20,000	15	PP 2A3's A OR AB1 TO VC
809-26	500	2, 3.7, 8, 12.5, 15	1	50-20,000	15	LINE TO VOICE COIL
870-26	10,000	2 or 8	1	*20-20,000	6**	PP 6V6G's OR 807's AS TRIODE
871-9	10,000	2 or 8	1	*20-20,000	12	PP 6V6G's OR 907's AS TRIODE
872-9	10,000	3.7 or 15	1	*20-20,000	12	PP 6V6G's OR 807's AS TRIODE
891-22	6600	83, 100, 125, 166, 250, 500	1	50-12,000	35	PP 807's AB1 TO LINE
892-22	3200	83, 100, 125, 166, 250, 500	1	50-12,000	55	PP 807's AB2 TO LINE

DRIVER TRANSFORMERS

545-9	SE 4000 TO PP AB2 GRIDS 1.6:1. PRIM. TO ½ SEC RATIO 50-10,000 CPS 5 WATTS
588-6	SE OR PP 5000 TO PP 807's CLASS B. 200-5000 CPS 5 WATTS

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uch as mica, ceramic, and first-grade paper types.

The electrometer can be used to heck ion-chamber current in radioctivity tests in the manner illusrated by Figure 3 (D). The polarisng voltage is applied in the correct olarity to the ion chamber in series vith a high-grade capacitor, C, of ccurately-known capacitance.

Radiation causes ion charges to be tored by capacitor C. The electroieter voltage deflection, E, then is roportional to the radiation Q=CE).

Other current measurement aplications of the electrometer include hecking of (1) vacuum-tube grid urrent (2) low-order currents in imly-illuminated photocells and hototubes, and (3) surface leakage n insulators.

C POTENTIALS

DC potentials at high resistance re checked readily with the electroeter in many circuits in which the omparatively high resistance of a acuum-tube voltmeter is unsatisctorily low.

When the test voltage exceeds the aximum deflection provided by the ectrometer range switching, an xternal high-resistance voltage vider (R1, R2) may be used, as own in Figure 4. The unknown ltage E1, then will be equal to 2, R1, R2)/R2, where E2 is the ectrometer deflection in volts, and and R2 (the voltage-divider retance arms) are in ohms or megms each.

Figure 4 (B) illustrates measureent of the open-circuit voltage of DC power supply having high innal resistance Rg.

The accurate measurement of h a terminal voltage (a resistor-nited constant-current transistor s supply is an example) would st a problem if only a VT voltter were available, since the innal resistance Rg would form a tage divider with the voltmeter ut resistance.

The arrangement in Figure 4 (C) ables the measurement of the rged voltage and leakage rate of ample capacitor, C. R1 and R2, if uired, are chosen in value so that ir total resistance is much higher n the leakage resistance of the acitor.

THOD

witch S is thrown first to posin A. This connects the capacitor oss the polarising voltage source charges it. The switch then is own to position B, connecting the rged capacitor to the electrometer ough the voltage divider.

he initial deflection of the elecneter shows the charge voltage he capacitor, and the decline of reading with respect to time intes the discharge of the capaci-

his type of test perhaps is more cative and valid when the exter- voltage divider (R1, R2) can be tted.

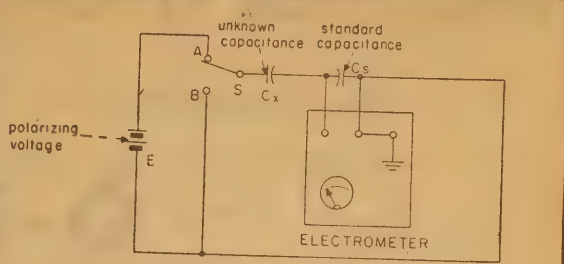
hen capacitor C looks into the high resistance of the electroer.

e static potential at a vacuum- electrode in series with a high tance is measured accurately the electrometer. The control is an example. Figure 4 (D) s the connections for checking static grid potential across a high value of grid resistance, Rg.

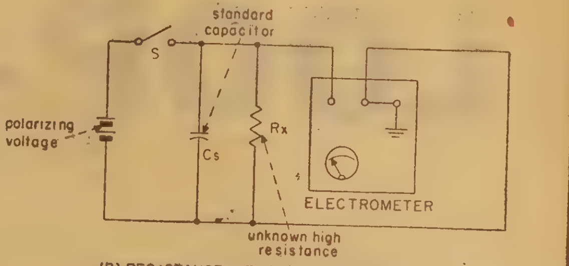
Other applications involving the use of an electrometer to measure potentials include checking of (1) piezoelectric crystal voltage, (2) output of slightly-heated thermocouples, (3) contact potentials, (4) static electricity, and (5) physiological potentials in biological and medical research.

The high input resistance of the electrometer permits determination of capacitance by DC methods. Figure 5 (A) is an example.

Here, Cs is a high-grade standard capacitor of accurately-known capacitance and excellent leakage characteristics.



(A) CAPACITANCE MEASUREMENT BY SERIES-C METHOD



(B) RESISTANCE MEASUREMENT BY RC-DISCHARGE METHOD

CAPACITANCE AND RESISTANCE CIRCUITS

FIGURE 5

The polarising voltage, E, also is known accurately. The capacitor shunts the electrometer input terminals.

Capacitor Cx is the unknown unit. Capacitance is determined in terms of charge division between the standard and unknown. With switch S in position A, the capacitors charge in series. The voltage reading e, of the electrometer is noted. The unknown capacitance Cx equals (Cse)/(E-e).

High resistance values may be determined from the measured time constant of a circuit containing the resistance (Rx) and a charged capacitor (Cs) of accurately-known capacitance, as shown in Figure 5 (B).

When switch S is closed, capacitor Cs is charged to the potential of the polarising voltage, and this value is indicated by the electrometer. When the switch is opened, the capacitor begins to discharge through Rx. The discharge rate then is accurately timed up to the point at which the electrometer voltage deflection has fallen to 37 pc of its initial value.

The unknown resistance, Rx (in megohms) equals t/Cs, where t is the discharge time (in seconds) and Cs the standard capacitance (in microfarads).

STERILISATION BY LIGHT RAYS

(Continued from Page 17)

micidal lamp. What a boon this must be to the surgeon, for he knows that not only are his instruments sterile by boiling, but the very air his patient breathes is free from harmful bacteria which could fall into the wounds and cause infection. The germicidal rays also keep his hands and clothing sterile while he works.

The application of these powerful germicidal rays is simple in the extreme. It simply consists of suspending the tubes from the ceiling or walls or directly over the point which must be sterilised. In air conditioning ducts, the lamps are placed so that the air passes through the rays.

Certain precautions must be taken but these are simple and the manufacturers have studied the matter so deeply that no harm can come to man or animal if the instructions are carried out.

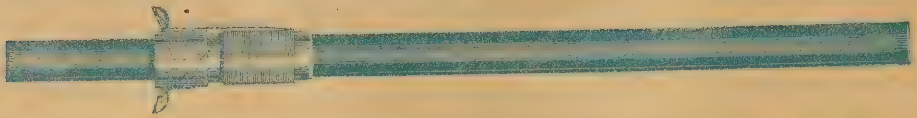
No doubt one very promising application is the use of a small lamp in domestic refrigerators. By installing the lamp so that it could be switched off independently of the refrigerator unit it will be possible to give the air inside the refrigerator treatment when required. By this means, higher temperatures and higher humidities can be maintained in the refrigerator.

Thus with the advent of this marvellous germicidal light science has added another amenity to the comfort of man and his fight against disease.

Salt content of the seas varies from 3.3 to 3.8 pc of the weight of the water, and temperature of the open oceans from slightly below freezing to 86 degrees Fahrenheit. These differences are wide enough to permit indentification of any mass of water. For instance, warm extra-salty water from the Mediterranean can be followed for thousands of miles, and so can cold Baltic water, which is low in salt.

ANOTHER 1954 Q-PLUS RELEASE

THE "Q-PLUS" LOOP-STICK



The Q-plus loop-stick replaces conventional loop aerials, and aerial coils for normal broad cast receivers giving FAR superior performance and ease of mounting. It may be mounted with out serious loss of performance close to batteries and other metal objects. It comes supplie with mounting feet and instructions.

FEATURING

FERROXCUBE
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INC. 16-2/3 pc
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Q-PLUS LA1 ANTENNA ROD

AN AERIAL COIL WITH HIGH SIGNAL PICKUP

FREQUENCY COVERAGE:
520—1600 Kcs

TUNING CAPACITY REQD.:
25—445 pf inc. strays.

PHYSICAL SIZE:
8⅛in long x ½in w/o terminals.

CONNECTIONS: Either terminal to grid; other one "E" or AVC.

MOUNTING: Either with brackets supplied or by any other means.

INDUCTANCE OF COIL IN AIR: 16 uH.

INDUCTANCE OF COIL ON CORE—At 1 M/c: 210 uH.

AVERAGE "Q" OVER BAND: 230.

REMARKS

Use as ordinary loop aerial or aerial coil.

HOW TO USE YOUR Q-PLUS LOOP-STICK

If you already have a port able—simply disconnect th loop and re-wire to "Q-plus loop-stick — re-align as pe instructions and then you signals should be louder an clearer.

If you already have an A set—disconnect your aeri coil and aerial—re-wi loop-stick to grid and A.V. connections—and there y are.

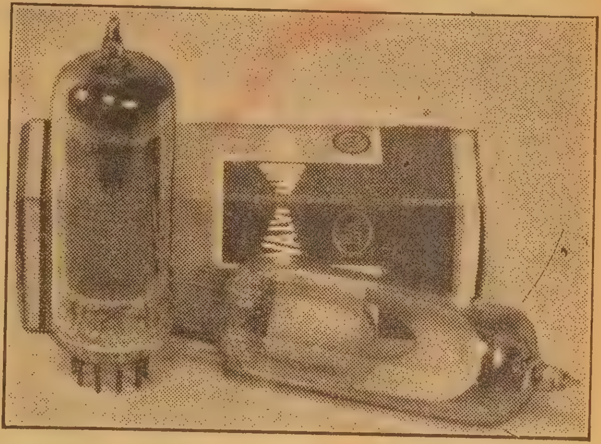
N.B. It is not recommend that country listeners do th

R. W. STEANE & CO. PTY. LTD., AUBURN, VIC.

TRADE REVIEWS AND RELEASES

NEW VALVES, CRYSTAL DIODES, RELEASED BY S.T.C.

STC have announced the local release of two interesting new valves, a power pentode having a very high mutual conductance and a new "magic-eye" type of tuning indicator. The same firm also carries a number of crystal diodes which should be of interest to experimenters.



Pictured on the right are two of the latest valves released by STC. The 6CH6 high-slope pentode is shown standing upright, while the EM85 is lying on its side. The target occupies the whole upper portion of the envelope.

THE 6CH6 high-slope pentode is manufactured in England by rimar and is intended primarily or use as a video amplifier valve. owever, its general characteristics ake it suitable also for audio aplications.

As a single-ended pentode, the CH6 is rated to draw a total cathode urrent of 46 mA at 250 volts, delivring three watts of power to a 000 ohm load at 8.5 pc distortion.

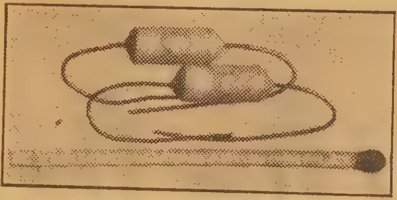
It may also be used with reduced creen and bias voltages, the mutual onductance figures ranging for hese applications between 11 and 3 milliamps per volt.

This would make the tube a good roposition for mantel type receivrs where the output stage needs have a very high power sensivity. It uses a noval base.

The tuning indicator is produced Lorenz and carries the type numer EM85. It contains triode and rget structures, in the usual way, t the fan-shaped pattern is procted completely clear of the inrnal electrodes.

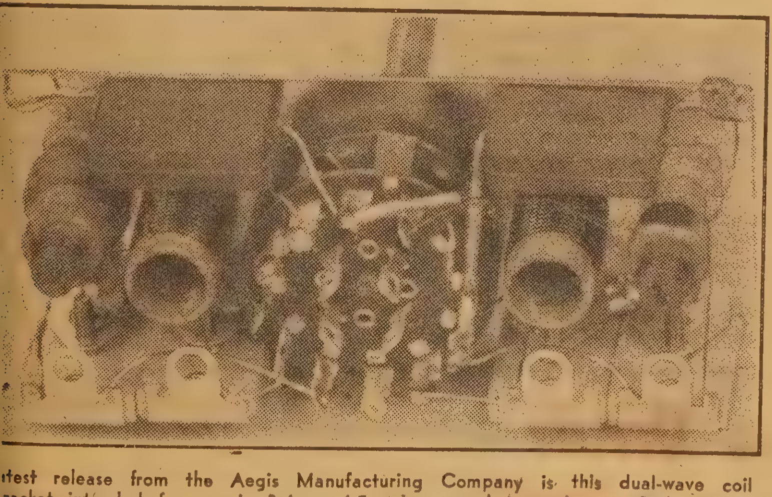
Assembled in a small envelope on noval base, the indicator can adily be mounted on to the dial ckplate and seen through the noral dial glass.

The crystal diodes type GD3 and D4 are germanium types intended imarily for use as detectors and ak limiters in television receivers. They may, however, be used in a variety of other applications. Both have the same forward characteristic, but the GD4 is recommended for applications where high peak inverse voltages are anticipated.



Two germanium crystal diodes now available from STC. They are listed as types GD3 and GD4 and may be regarded as interchangeable for most low-voltage applications.

AEGIS DUAL-WAVE COIL BRACKET



test release from the Aegis Manufacturing Company is this dual-wave coil racket intended for use in 3-4 or 4-5 valve superhet receivers. Body of the it measures approximately 3¾ x 1½ x 1⅛in deep. It covers the broadcast band and one short-wave band, 16-50 metres.

HIGH VOLTAGE IRC RESISTORS

Messrs. Wm. J. McLellan & Co. Ltd. have announced the release of a new line of resistors intended for use in applications where a high degree of stability is required under conditions of high applied voltage.

PHYSICALLY, the resistors are produced by applying a spiral conducting path to the surface of a high quality ceramic tube. This produces a very long conducting path and effectively reduces the potential per unit length of such path.

Applications suggested for the new resistors include voltmeter multipliers, high resistance standards, high resistance bleeders, grid leaks and voltage dividers, such requirements being commonplace in x-ray, cathode-ray, photocell circuits and such like.

Data charts available from the manufacturers show that the resistors are available with a variety of terminal arrangements, with power ratitngs from 2 to 90 watts and peak voltage ratings from 5000 to 100,000 volts.

The range of resistance available varies with the size of the unit, but the figures show a minimum resistance of 2500 ohms for the smallest unit to as high as 20,000 megohms for the largest. Dimensions range from 1¾ x 5-16in to 8½ x 2in, again depending on the power and peak voltage rating.

Makers' specifications list tolerances available, temperature rise against load, temperature derating curve, effects of forced air cooling, methods of assembly, &c.

Full details are available on application to Wm. J. McLellan & Co. Pty. Ltd., 126 Sussex St., Sydney. (Phone BX1131).

Let's Buy An Argument

These "argument" columns are a wonderful boon to other members of the staff. Whenever a subject looks like getting too involved or controversial for reasonable treatment elsewhere in the magazine, it stands a fair chance of being passed over to Yours Truly on the basis that "It's wonderful stuff for Argument".

by Neville Williams

LATEST example of this touching generosity has been provided by the editor with his brief article in the July issue entitled "Some Thoughts On Enclosures."

I could only prophesy that he would "get some bites" with it—and he certainly did! One reader began, as you can see, by querying the enclosure's behavior at resonance, proceeding thereafter to decry our tendency to publish what he refers to as "corny" explanations of technical problems.

QUITE DELIBERATE

Without trying to debate the meaning of the word "corny", I can only say that many of our articles are phrased quite deliberately for readers with a limited technical knowledge; for readers who don't live in a perpetual world of maths and physics. This one was specifically written for record enthusiasts rather than radio experimenters.

For many such folk, radio (or audio) is merely a hobby and highly technical articles are well above their heads. But they still like to have some idea of what goes on and the best way of telling them is by writing in terms which they can understand—terms which this particular correspondent apparently chooses to brand as "corny".

Quite possibly, the editor's recent article on "High-G Records" was "corny" by these standards, but it still proved to be a very popular article. It was even reprinted, both in Australia and overseas, for distribution among Sales Personnel, who rarely see farther into an amplifier than the pickup arm.

It's all part of the pattern which has given Radio and Hobbies its distinctive character and kept it as a going concern for a good many years.

However, it's not my intention to spend a whole article debating our editorial policy. Sufficient to say that we try to cater for the beginner and the hobbyist, as well as for those a little farther along the road.

We're quite happy to leave the highly technical approach to the contemporary mags. which prefer it. Good luck to them!

This much I must say: The editor's remarks about vented enclosures were the outcome of a good deal of thought and discussion on the subject. There's a lot more behind them than can possibly be compressed into a couple of columns.

With this in mind, let's talk for a while about speakers and baffles and, in particular, vented enclosures.

If what I say proves more lengthy and involved than usual, I can only crave your indulgence.

BOOKS AND MORE BOOKS

Before sitting down to write this, I spent several hours just browsin through references to speaker baffling, dating from about 1940 onwards. Whether I am really ver much wiser is debatable.

It is in very truth a "baffling" subject, so complicated by indefinit quantities that it almost defies precise analysis. It's a stamping groun for everyone, ranging from mathematicians and engineers, through "audiophiles" with a flair for ca pentry.

"Theory" and "practice" are oft yoked uncomfortably together.

Some writers prefer the mathem tical and "equivalent circuit" a proach, analysing the performances various baffles and the factors whi influence the end result.

That is indeed one thing, but is quite another to write into thei formulas the figures which appl for the speaker you want to us and the plywood and the paddin you have to buy from the loc store.

Others have been able to bu baffles of one type or another a test them with calibrated equ ment. However, the same type query still follows: Can I duplic those results with the compone that I personally have to use?

What of the articles based on "I-built-it-and-it-w o r k s-fine" a proach? How many are based on g design and how many on a m happy combination of circumstanc What faith can you place in judgment of an enthusiast on other side of the world?

Whichever way you look at the subject, it's impossible to avoid the question marks, and rather large ones, too!

And, of course, over and above the mere choice of components comes the matter of the listening room itself. Will the natural modes of oscillation in my listening room be favorable or will they overshadow the special merits of the baffle system?

However, there's not much future in becoming completely obsessed by such queries.

It's much more logical to try to "average out" the conflicting claims and evidence and to reach a conclusion that "for my particular case, such and such a baffle and speaker system appears to be the best compromise".

And of this we can be sure: Whatever system we do adopt and thereafter sponsor, it will be a compromise—one way or another!

"ARTIFICIAL" SOUND

In fact, more than that, it will be part of a system which is manifestly artificial, if only because the sound issuing from it lacks that very important feature of spatial distribution.

The perfect sound system just doesn't exist. It probably never will.

For an informed enthusiast, the objective is surely not perfection, so much as a system which pleases his ear suits his pocket and conforms to his technical ideas.

However, we are in grave danger of becoming lost in a maze of generalities. At this stage, we might well take our own advice and try to reach some conclusions about baffle systems by "averaging out" all the things said about them.

Flat baffles don't present much of a problem and I think we can accept Olson's well-known curves, which indicate that they maintain reasonable efficiency until the acoustic path from front to back of the cone approximates a half wavelength. Below this frequency, the response drops off by about 6 decibels per octave.

The same curves show a sharp dip in the region where the path is a full wavelength and Olson points out the desirability of mounting the speaker off centre to disperse the various dimensions and their effects

☆

He concludes that flat baffles are not very popular because the dimensions necessary for sustained bass response are too large to accommodate in an ordinary room.

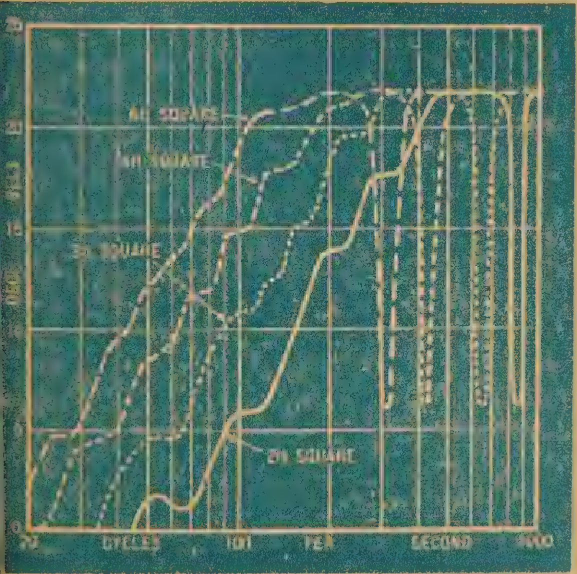
Occasionally we hear from folk who, misguidedly or otherwise, will have no dealings with anything remotely suggestive of resonant columns or chambers. They prefer the "good old honest baffle" and maintain that they hear bass from it a lot farther down the range than theory suggests they should.

By way of rejoinder and comment I can volunteer three observations:

(1) It's quite clear from the curves that flat baffles don't have an abrupt cut-off frequency. Rather do they exhibit a frequency below which the response tapers off at a definite rate.

(2) The response below this "roll-off" frequency is often sustained artificially by the speaker's own resonance or by bass boosting in the amplifier.

(3) Very few people ever use a "good old honest baffle". Standing them on the floor extends their apparent area. Placing them across a corner can produce rear-loading effects approaching those of an open-backed cabinet.



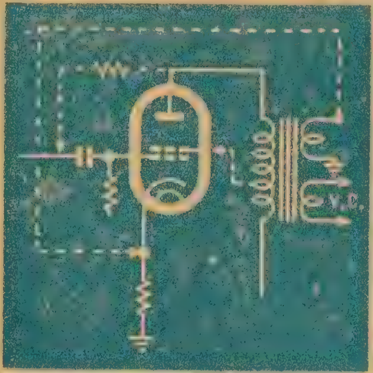
Typical curves which show the performance of a speaker on baffles of different dimensions. In practice, flat baffles are usually placed against floor and walls which not only extend their apparent dimensions but can introduce reflection and enclosure effects behind the cone.

"A VERY CORNY EXPLANATION"

Mr. Moyle or Mr. Williams:
Dear Sirs,

I have three small matters to mention which you may find useful or controversial, or something.

First, the article on enclosures, p. 97, July issue "The design of the enclosure is worked out so that it has a resonance corresponding with the loudspeaker itself. Because of this fact, the speaker finds it harder to develop output at this resonant frequency . . ." Please! Have you forgotten your reputation? Or have you "taught me wrong" in the past?



Secondly, in reporting recent developments or inventions, you have occasionally given a very corny explanation such as one would expect in the women's column of a daily. In a magazine such as yours we would rather expect a technical explanation or else just "how it functions we don't know".

Thirdly, I think that the idea of taking the screen supply for an output valve from a tapping on the primary of the output tranny is nothing more nor less than negative feedback. (Reported in Radio and Hobbies about 18 months ago.) Consider the several ways in which feedback might be applied over the output stage:

It may be applied to either the cathode, or the control grid, or the screen. The signal to be fed back may be collected at the plate, or from a secondary winding of the output transformer. The latter may be in the form of a secondary coil wound specially for the purpose (never done of course) or preferably, from the voice coil circuit.

Another form of secondary would be a section of the primary, similar to the aerial-coil windings where the primary is often a tapped-off section of the secondary. Three of the numerous possible feed-back routes are shown by dotted lines.

The tap on the primary would obviously be very suitable for feeding direct into the screen. There would probably be a number of advantages with such a tight little loop, such as the original investigators described. In conjunction with a loop from the voice coil back to the input stage, I imagine it would increase efficiency and stability, if only by "division of labor".

As it is such a beautifully simple arrangement, surely the transformer manufacturers could make arrangement for tappings in output transformers in case the user should want them.

The foregoing applies also to push-pull output of course: I have considered the straight output for simplicity.

Best wishes for your journal — I look forward to it each month.

Yours sincerely, J. S.
(CLAYTON, VICTORIA)

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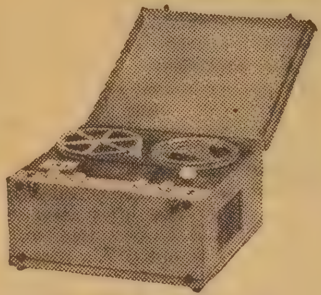

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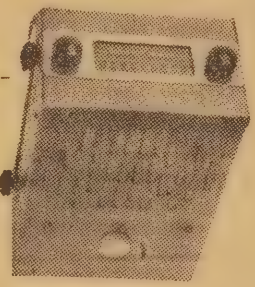

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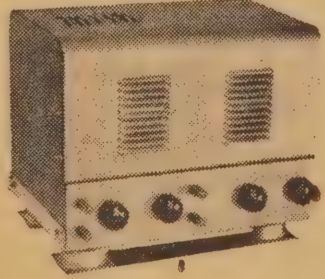

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I can't recall ever having seen a domestic set-up with the baffle suspended in free space. I've seen them across corners, plenty of times!

RADIO CABINETS

Which brings us, of course, to that ubiquitous piece of furniture-cum-baffle called an open-backed radio cabinet.

Not even the sage himself could define these as "good" or "bad", from the fidelity angle, because they range right through from "passably good" to "fair", "poor", "bad" and "atrocious"! They can be referred to only in very general terms.

Small mantel type cabinets and speakers simply cannot produce good bass, no matter how many fronts, backs, apertures, throats, louvres, frets or sales executives they may boast.

The best they can do is to create an illusion of bass by boosting, frequency doubling or treble suppression.

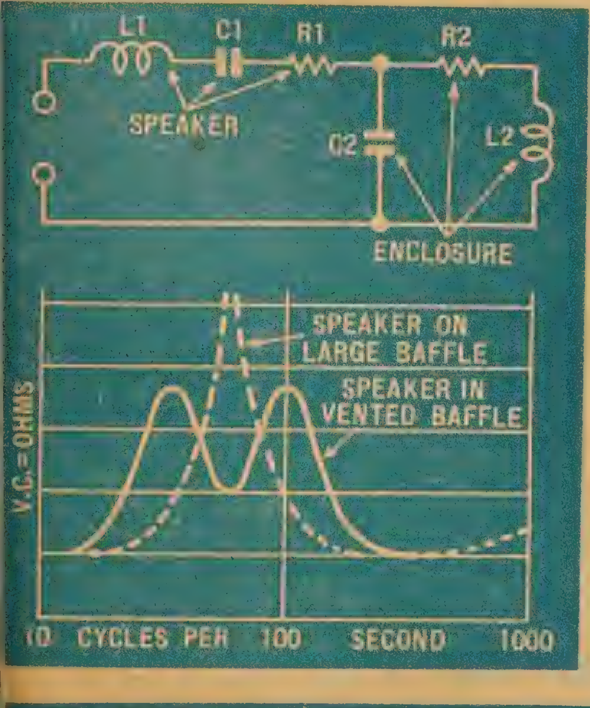
One often hears about the "phenomenal bass" from some particular small set, or the virtues of a wooden over a bakelite cabinet, &c. Unfortunately, none of the sets concerned stands up to a test with a very simple piece of equipment—an ordinary tape measure run from front to back of the cone. It tells more about cut-off frequency than a whole torrent of words.

BETTER PROPOSITION

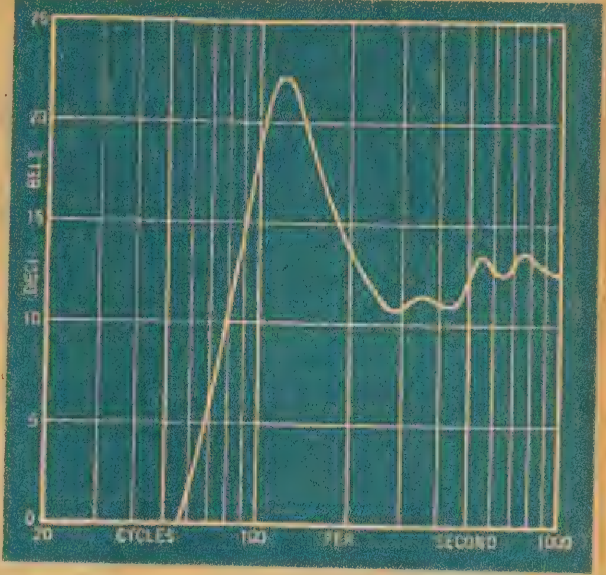
Console cabinets are a much better proposition in this respect, but the results can still range all the way between "good" and "bad".

What can happen in a bad case s shown by yet another of Olson's curves (figure 2). Here the characteristics of the cabinet combine with hose of the speaker to produce a prominent resonance at about 120 ps, with a steep roll-off below it.

This condition is responsible for what is classically known as "one-ote bass".



The equivalent circuit and curves classically quoted for a speaker mounted in a vented enclosure. Enthusiasts often forget that the curves show impedance variation and do not necessarily represent acoustic output. The vital query, however, is the degree to which overall acoustic output is affected (a) by amplifier impedance and (b) by the amount of damping commonly used in ed enclosures.



This curve illustrates what can happen in an open backed radio cabinet, when the speaker and cabinet characteristics combine to produce a single prominent resonance curve. The effect is further aggravated if the output stage has no feedback to control the cone electrically.

I remember, in my younger days, a set next door which suffered very badly from this effect. One always knew when the said radio was on from the series of "boomps" which filtered out through the window. It was rather like listening to a Salvation Army band — minus the brass!

Fortunately, the majority of consoles nowadays aren't quite as bad as that, the cabinet space being broken up by sundry partitions and the speakers having a resonance further down the range.

In fact, as I have stated on a previous occasion, the combination of a large substantial cabinet and a good quality speaker can sound quite pleasant at moderate volume and assisted by a discreet amount of bass boost.

But the words "moderate" and "discreet" are very important in this last statement. The substitution of boosting for really good baffling places added demands both on the amplifier and the speaker, as turning up the volume will very soon discover.

That is why most audio fans, sooner or later, ultimately tackle the job of providing a more ambitious type of baffle.

But what kind of baffle is the problem. You can have airtight boxes, vented enclosures (large and small), R-J ditto, folded horns, horn-cum-baffle combinations, column loading arrangements and many others. All can find ready and enthusiastic sponsors—to the dismay of credulous readers!

There may, in fact, be a very simple explanation for this last state of affairs—I mean the sponsors.

For very obvious reasons, people don't build baffle systems one after the other, with the idea of trying them all out. They cost too much; take up too much time and space. As a result, the odd ones that are built by many individuals are compared with the thing they've been used to—an ordinary radio cabinet!

It isn't unreasonable to expect that almost any logically built baffle will thus be an improvement and give its builder some cause for enthusiasm.

Perhaps I'm uncharitable but I can't help but feel that this is at least a partial explanation for the glowing reports that one sometimes hears about speaker housings built with fancy reflectors, sounding boards, loading chambers, horns that aren't and so on.

JUST ORDINARY

They may suit a particular situation and they may all work in a fashion but don't be surprised if the results are just ordinary.

This isn't meant as a wholesale condemnation of new approaches and new ideas. Some may be interesting, for their compactness or their simplicity; some may achieve special "effects"; none of them, to my knowledge, have been proved to have any magical qualities.

As far as I can see, the vented enclosure remains as just about the best all-round compromise between appearance, simplicity and performance. This view appears to be shared by plenty of other folk in the audio world.

But what, may I ask, is a vented enclosure? Is it just a big box with

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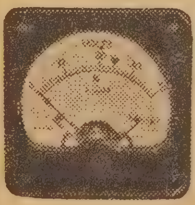

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a couple of holes in the front or is it a thing of critical design?

I wouldn't be very far from the truth in suggesting that it can be either, depending on circumstances.

To understand why one can say this, it is necessary to start right back with the speaker itself.

As most of us are well aware, the vast majority of speakers have a cone assembly which is sufficiently massive and sufficiently springy to have a definite resonance somewhere in the range below 100 cps.

In this region, the cone tends to move more easily, the acoustic efficiency rises and, for a given amount of driving power, the output also rises.

At the same time, the voice coil impedance may increase in value by several times at resonance, thereby affecting the load which the speaker presents to the amplifier.

In general, all these effects are undesirable but just how serious they are in practice depends entirely on the design of speaker and the way it is used.

LIKE TUNED CIRCUIT

For the purpose of analysis, engineers commonly regard the behavior of a speaker at resonance as analagous to a series-tuned circuit. They liken the inertia of the cone to inductance, the springiness of the suspension to capacitance and factors like stiffness and air loading as resistance.

On this basis, they can talk about the apparent "Q" of the system and show that the resonance peak will become less marked as damping is applied to the suspension system and air loading on the cone increased by suitable baffling.

This kind of analysis leads logically to the query: Can some kind of baffle system be devised which will specially load the cone at its natural resonant frequency?

The answer (you've guessed it) is the vented enclosure.

The engineer types, as aforementioned, have worked out that a vented enclosure is analagous to a parallel tuned circuit with the mass of air in the throat (or vent) equivalent to the inductance, the quantity of air inside equivalent to the capacitance, and factors like internal damping and throat output to resistance.

By correctly proportioning these quantities, it is thus possible to produce an enclosure characteristic which is complementary to the speaker characteristic in the region of resonance.

REAR LOADING

At the very frequency where the one wants to increase its amplitude f movement, the enclosure (because it is also resonant) effectively inverts he phase of the pressure wave deeloped by the rear of the cone.

This puts the radiation from the ent in phase with that from the front of the cone. Therefore, both surfaces of the cone are subject to coustic loading and its freedom of movement is thereby restricted.

(It also accounts for the wording in the Editor's statement a couple of months back and which our correspondent has queried.)

This selective restriction of the cone movement at resonance prevents the sharp rise in voice coil impedance and produces an impedance curve similar to the one shown in Figure 3.

It is important to realise that this familiar diagram is essentially an **impedance** curve. It is related to the **loading** on the cone but is not ncessarily a direct indication of total **acoustic output.**

The two smaller peaks on either side of resonance are reckoned to be due to the interaction of the components in the series and parallel-tuned circuits—in other words, the speaker and the baffle.

Any two circuits tuned to the one frequency and intimately coupled tend to produce comparable effects as, for example, do the components in a band-pass radio tuner.

It is interesting to note also that the vented enclosure is more or less unique in specifically combating cone resonance. Horns, baffles, &c. merely provide a general degree of air loading which is no heavier at resonance than it is at adjacent frequencies.

Whether it needs to be, we shall see presently.

BUT—and it's deliberately in capitals—we should be very glad that we don't have to rely purely on an enclosure to combat cone resonance.

If we did, we should logically have to follow some rigid test procedure to get the speaker and enclosure resonance exactly coincident. This would involve precise adjustment either to enclosure volume or to throat dimensions, or to both.

We should also have to make sure that the "Q" of the enclosure matched up with that of the speaker, so that the net acoustic output from the whole device was as even as possible.

CUT-AND-TRY

One gentleman has quite a story to tell about adjusting enclosures with this objective in view (Audio Engineering, July, 1948).

But I'm very glad that we can be spared adjustments of such a critical nature—even though it means derating somewhat the value of Figure 3.

I'm very glad, too, that the amplifier itself is able to discipline the speaker's behavior at resonance — and very effectively! Let's see how this comes about.

Most amplifiers, these days, have a very low output impedance, either because they use triode output valves or because they employ negative feedback. Perhaps they do both. As a result, the voltage across the voice coil is largely independent of frequency or of variations in voice coil impedance.

Therefore, if the voice coil impedance does tend to rise—as it normally will at resonance—the voltage from the amplifier will not rise with it.

The current through the coil simply falls and with it the driving power to the cone.

In other words, a low impedance amplifier tends to offset the rise in speaker output at resonance by a reduction in driving power.

That is why it is possible to run over the bass register with a good quality speaker, operating from a low impedance amplifier, and hear very little evidence of cone resonance—even with the speaker completely unbaffled.

In searching for the resonance of some speakers, I have frequently had to insert resistance in series with the voice coil circuit and use a meter to identify the rise in impedance.

Such a statement simply means that, in many cases, cone resonance is not a serious problem, insofar as it affects acoustic output.

Why then take extreme measures with tuned acoustic damping?

Now—and here we come to the point of the editor's remarks in the July issue: What account have vented enclosure sponsors taken of this electrical "damping" on the speaker? Is it correct to use a vented enclosure at all for a speaker whose resonance is so effectively cancelled by other means?

From what I've been able to discover, these are points on which most writers appear to have been strangely silent.

It has been suggested that a highly resonant speaker works best with a relatively bare enclosure; that a well-damped speaker should be used with a heavily padded enclosure. Further that there is an optimum ratio between enclosure volume and throat (or vent) dimensions for each case.

WHAT DO THEY MEAN?

Such observations are doubtless along the right lines, but are they so vague as to be meaningless?

My tip is that they don't have to be very precise.

In this enlightened age, very few audio enthusiasts try to use highly resonant speakers and high impedance amplifiers. Presumably, they are the only folk who would need critically adjusted enclosures, and I would seriously doubt such folks' ability either to make such adjustments or to pass an opinion on the end result.

The vast majority of informed enthusiasts use speakers in the medium to good quality class and low imped-

(Continued on Page 102.)

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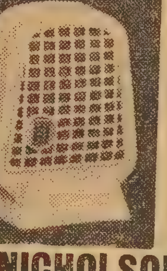

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OFF THE RECORD — NEWS & REVIEWS

As time goes by, we become increasingly aware of much music which we would never have heard in the old 78 era. This month is a case in point. It has brought me several albums of modest weight which represent something like 35 old timers and several tons in weight. To say nothing of the route march needed to effect the necessary turnovers!

By JOHN MOYLE

THE best performances in the world could never have stood up to the sheer nuisance value attached to the 78's. Don't you often wonder how you ever put up with them?

This month's records are a pretty good bunch, and between them represent some fine work.

BACH—St. Matthew Passion. Orchestra conducted by Hermann Scherchen with Magda Lazlo (soprano), Petre Munteanu (tenor), Hugues Cuenod (tenor), Hilde Rossl-Madjan (contralto), Richard Standen (bass), and Heinz Rehfuss (bass) with chorus. Westminster WAL403.

To this set of three discs I give my highest five star award, and it takes it on all counts.

St. Matthew Passion is not everybody's music, but I am convinced that this is partly because everybody hasn't had the chance to hear a performance of this order. I must admit that I am less attracted to long works of a religious nature than to other musical forms, but I was completely enthralled by this recording — by the dignity and stature of the music, by the sincerity and vitality of the performance, and by the superlative work of the technicians who recorded it.

NONE BETTER

In fact I think it would be extremely difficult to visualise a better recording of this being issued under present standards, because it measures up to the best of them as they exist today.

No recording will ever be perfect and there are a few criticisms I could make concerning the balance between orchestra and voice in one spot, or the temporary deficiency of a singer in another. But there is nothing from start to finish which could be called tragic or even serious, and in the face of such a high standard, such criticism could not detract from the overall merit.

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There are some fine singers here, particularly Heinz Rehfuss whose bass solos are outstanding examples musically and technically. We rarely find a work of this type in which there is not a weak contributor. Here they are first class. The work of the choir, too, is very fine.

The surface noise is for the most part inaudible, giving virtually a completely silent background.

If you take your library building seriously, I think you could safely include this album despite its three discs and high cost. It is, I suppose, one of the greatest musical works ever written, and if you can take the trouble, you will never cease to find new interest in the music, its history, and its drama.

GLIERE — The Red Poppy Ballet Suite — Symphony No. 3 in B Minor (Ilya Mourometz). Played by the Vienna State Opera Orchestra conducted by Hermann Scherchen. Westminster WAL 210.

Most reviewers seem to be attracted to the Red Poppy which fills the fourth side of this set, mainly I think because it is interesting as an example of a ballet written on strict "party" lines with the wicked representative of Capitalism being shown up for the cad he is and the vindication of the kind Soviet captain. But the music isn't very distinguished although some of it will be familiar to ballet minded readers.

I was far more interested in the Gliere Symphony, which is really a colossal tone poem about the bogatyrs, the fabled equivalent of the ancient and noble heroes which appear in the folk lore of almost every country.

STRONG INFLUENCES

Gliere is a most competent writer of colorful and dynamic music in which we hear strong influences of almost every standard Russian composer at work, including Tchaikovsky, Moussorgsky and again of Wagner.

Against the length of the work must be weighed the colossal standard of the recording, which for sheer weight and range is the equal of anything the Vienna players have done. If you have a wide range equipment you will get a real thrill from these records every five minutes. But it isn't just noisy, there is very good quality to be heard in the general tone, and although forward, orchestral balance is handled most convincingly. The recording level reaches incredible amplitudes, and if there is any surface noise it is mostly completely submerged.

Musically and technically I found it unusual, stimulating and exciting.

MAHLER—Symphony No. 2 in C Minor (Resurrection), played by the Vienna Symphony Orchestra, conducted by Otto Klemperer, with the Akademie Kammerchor, Ilona Steingruber (soprano) and Hilde Roessl-Majdan (alto). Festival-Vox CFR12-83.

As a performance I do not think many people will be disappointec in these records, although I cannot claim much concert experience of it and I doubt whether many car either.

What I mean is that the orchestra seems to handle the work adequately and wtih more cohesion than I would have thought possible with such an interminable protestation of faith for Mahler was very serious about this work, and wrote a great dea of sincerity into it.

But to me it lacks conviction in proportion to its size—I can take slabs of it with interest, but I cannot take the whole of it withou thinking of something else. I agree with someone who said that Mahler's Heaven must be a very noisy place if the last movement is a sample.

BEAUTIFUL SINGING

The best part, I thought, was th lovely third movement in which th alto sings that exceedingly simpl and beauiful song—a prayer if yo like. She has a really lovely voic and her work shines like a welcom candle in a tempest of fury.

The recording is most impressiv for its dynamism, but is rather to forward for such a huge orchestr and tends to become noisy. Als there is some mike juggling whic is pretty obvious in pulling odd in struments to the fore. A generall faint aura of harshness makes little top cut a good thing—I foun it best with AES setting with or notch of treble, which makes near to NAB, The surface is fa only—my copy had some blemishe

HANS PFITZNER — Three Preludes from Palestrina, played by the German Philharmonic Orchestra, Prague, conducted by Joseph Kilberth.

CORNELIUS DOPPER—Ciaconna Golica, played by the Consertgebouw Orchestra, Amsterdam, conducted by Willem Mengelberg. Radiola-Telefunken, LSK-7012.

Both musically and technical this is a good disc. The music is widely known to the listening public and it is, in fact, greatly contrasted.

Dopper was a bluff Dutchman of considerable ability, and in this Chaconne he appears in his more academic mood—a lively and interesting work. The Amsterdam Orchestra has the edge, I thought, on that of Prague, although frankly the material allows them to shine more than that of Pfitzner. I liked the general orchestral balance very much, and there is plenty of bite and range, both bass and treble, to give your speaker a treat. As it cannot be a recent recording, it is all the more meritorious.

Pfitzner's music comes from his opera about Palestrina—a rather aesthetic work with a story and a moral of the type which occupied many of his school. It is pleasant enough to hear, although not particularly distinguished.

An unusual disc—technically one of Radiola's best. A very slight "swing" to one side may not be characteristic of the full run.

BEETHOVEN—Sonata No. 21 in C major opus 53 (Waldstein); Sonata No. 23 in F minor Opus 57 (Appasionata). Played by Walter Gieseking, pianist. Columbia 33CX1055.

If you are one of those who flinch at the prospect of hearing these well-known sonatas once more I suggest that you forget your fears. If you heard Gieseking play them during his recent tour you won't want my persuasion. For I doubt whether you are ever likely to hear more magnificent performances on records.

I say this not only because the standard of this disc will be hard to beat on its merits, but because the "old master" school of pianists of which Gieseking and Backhaus are two of the last, is rapidly dying. And, of the two, I think Gieseking is wearing the best, perhaps because he is the younger man.

ENTAL PROJECTION

There are some pianists whose bility, musical penetration and inellect allow them to project their ental processes so that the phycal act of music-making is, as it hould be, a secondary consideraon. Schnabel was perhaps the utstanding example, but Gieseking another.

I can only say again, therefore, at these are magnificent musical erformances. They are recorded ith a sonority and freedom from stortion, which allows full appreation of Gieseking's full-blooded namic range and power, although e piano tone is on the "woolly" de. The surface noise is virtually audible.

I can't imagine anyone going past is disc.

SIBELIUS—Symphony No. 2 in D ajor Opus 43. Played by the Orestra of the Concert Society, ockholm, conducted by Tor Mann. diolo-Telefunken LSK7007.

As a performance, this record is st impressive. I do not recollect aring more convincing Sibelius. r Mann is obviously a conductor o knows every note of the score, d misses nothing in the significe of a single phrase or climax. is is a fine symphony—touched th the Sibelius of Finlandia, but also indicative of the more austere music to come.

The orchestra copes with the terrific dynamic changes with great flexibility and power. Particularly good is the brass section, which has so much to contribute. The orchestra as a whole displays a fine and instant attack, contrasting beautifully with its smoothness as the music irons out into those sudden and heart-rending themes of which Sibelius makes such powerful use.

FORWARD

The recording is equally good. It is quite forward, but we never feel the tone thinning out or the flow slackening. A trifle more reverberation might have added mass to the sound, although it could scarcely have improved on its power which comes through so well. It has good frequency and dynamic range, exceptionally clear recording of individual instruments, and some remarkably fine bass particularly in the last movement.

The surface is quite good, although a little below first-class. If you like Sibelius, and even if you don't, you should hear this disc.

SCHUMANN—Kriesleriana Opus 16, Romance Opus 28 No. 2, Toccata. Played by Joerg Demus, pianist. Westminster WL5142.

In interpreting Schumann, Demus is a fine pianist—he also has that natural reflective quality of mind which is essential for such music. Solomon is another pianist with it. As a result we do not feel that there is any assumption of style required for this very Schumann-like music. It has authentic warmth and glow, which shows up particularly in the very fine performance of the Romance. A little more firmness here and there might have been an improvement, but that's a minor point.

The main work is very much a pianist's composition. Originally intended to be a series of sketches concerning a mythical and eccentric Kriesler (nothing to do with Fritz or his music!) is emerged more as a series of rhythmical studies than a clearly outlined musical portrait.

Noteworthy is the brilliant performance of the exceedingly difficult Toccata, in which Demus copes with its digital demands in effortless style.

The piano recording is fine—neither tubby, twangy, nor tinny. It has a slightly concert hall atmosphere, but is entirely convincing. The surface is satisfactory, although not completely quiet, but it passes.

CESAR FRANCK—Les Djinns. SAINT-SAENS. Carnival of the Animals. Played by L'Orchestre de L'Association des Concerts Colonne, conducted by George Sebastian. Nixa ULP 9099.

An attractive disc all round. The Cesar Franck is most reminiscent of the Symphonic Variations, and in some ways it served as a model for that more famous work. It is intended to follow an idea concerning some Arabian sprites in a poem by Victor Hugo, but to me the music has never been more than a typical piece of Franck piano and orchestra—very pleasant to hear, and on this record very well recorded. Annie Arco is a sensitive and well-equipped pianist with just the right touch.

The Carnival of Animals is at times a brilliant recording, and there are some realistic solo efforts. Both

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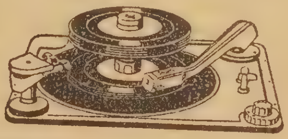

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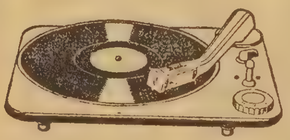

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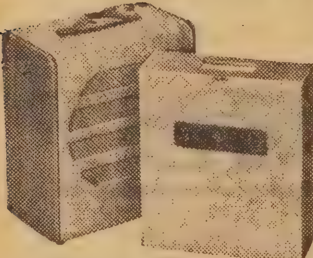

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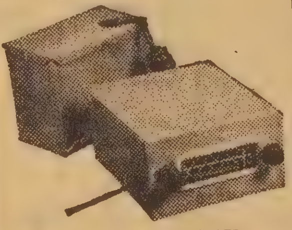

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sides have a reverberation I like which allows the pianos to merge into the orchestra in the way they should. The piano tone, too, is firm and convincing. Dynamic range is quite adequate and there are plenty of crisp highs. My main criticism concerns a slight tape hum on the Carnival. It may be due to the higher mike level called for by the rather remote recording, but it will show up on wide range gear. Surface noise is low and the disc plays cleanly.

ROYAL PROGRESS, 1954—SOUVENIR RECORDINGS. Radiola records.

Two 10in LP records containing highlights of the Queen's visit as heard through broadcasts, commencing with the arrival of Her Majesty at Sydney Cove and ending with her departure from Fremantle. They have been produced in collaboration with the ABC and recorded by Amalgamated Wireless (Australasia Ltd.). Naturally, most of the records are taken up with the Queen's various speeches, but we also hear others, including the Duke of Edinburgh, the Prime Minister (Mr. Menzies), Dr. Evatt, the American Ambassador and others.

GOOD EDITING

The editing of such a vast amount of material has been very well done, and the on-the-spot story of the announcers has the same spontaneous quality we heard at the original broadcasts.

It must have been a difficult task to even up the levels for the final tape and to decide what should and should not be included. Most people I'm sure will agree that both jobs have been excellent. The occasional use of music—bands, choirs, aboriginal welcomes and general background—helps to relieve what might otherwise have become merely a recital of speeches.

The records are housed in a most attractive folder, and make a unique souvenir of a memorable visit.

FAURE—Requiem, by the Roger Wagner Chorale and the Concert Arts Orchestra conducted by Roger Wagner. Soloists Patricia Beems and Theodor Uppman. Capitol CLCX023.

Faure's lovely Requiem is most effectively treated here in a good example of intelligent balance between orchestra, organ, choir and soloists. I would not say that perfection has been achieved, for, then, I would have to define it. Once or twice the choir sounded a trifle too remote, but I know if this had been rectified in one instance, it would have been too strong in the next. The whole set-up has been worked out in the recording hall, and then very wisely left alone to find its own balance.

SPATIAL EFFECT

As a result we get a spatial effect which is absolutely necessary to preserve the ethereal effect of sustained singing and playing in which reverberation of the right order is integral with the sound itself. All through the work the value of this effect is emphasised.

The soloists are good, particularly the baritone. His tone is a trifle plummy, but he sings with great sincerity and sensibility.

The performance in general is a little bit concertised, but not enough to spoil the spirit of the Requiem. Some of the choral effects are very fine.

The surface noise is quite low and the disc plays cleanly. I thought it a most distinguished performance.

TCHAIKOWSKY — Symphony No. 4 in F Minor Opus 36. Played by the Grand Symphony Orchestra of the Belgian National Radio Institute, Brussels, conducted by Franz Andre. Radiola - Telefunken LSK7009.

This is quite a good recording of the Fourth—brisker than Scherchen's version, reviewed last month, but possibly no more dramatic.

Scherchen's recording has captured more depth and contrast between sections, an example being that wild call of trumpets near the end of the first movement, answered by the horns. Scherchen has them in two different depths, the horns being furthest away, giving the effect of echoing the trumpets' statement. Andre has both brass sections in the same plane. I could refer to many such points of balance which illustrate the different approach.

Scherchen has the greater dynamic range, and the better bass, but Andre isn't badly served and has plenty of impact.

I'd say both versions are too for-

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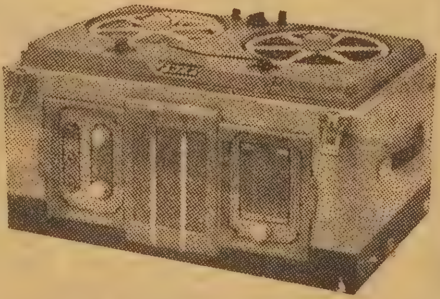
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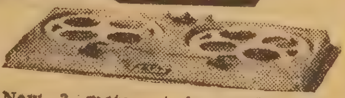
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ward for the very high pressure worked up in fortissimo passages. More remote mike placing and a little more reverberation would not have made so much noise, but would I think have broadened the musical picture, and made both recordings sound bigger than they do. At it is, both tend to become oppressive unless your room is a very big one, although Andre is possibly the better in this regard.

In the second and third movements it is Andre's turn to impress with some fine woodwind and pizzicato, which I thought better handled than with Scherchen, who sounds somewhat fussier, Scherchen, however, has much more weight and brilliance in the last movement, almost overpoweringly so. Andre is more subdued although by no means dull.

The Belgian orchestra in my view lives up to its original impression in earlier discs. In picking a "Fourth" you mustn't overlook this one.

Surface noise is fairly good, but not entirely absent.

CHOPIN — Waltzes Nos. 1-14. Played by Dinu Lipatti. Columbia 33CX 1032.

Almost perfect Chopin playing with a full and sensitive sense of rhythm, line, and the spirit of the waltz as Chopin saw it. It is hard to imagine, when one hears such ease and refinement of playing, that these waltzes can ever sound the dull things they are under less practised hands. Sometimes we hear more body than Lipatti gives, but he sees nothing hidden in the music nor does he attempt to imply it.

The recording is completely relaxed and clean. The net result is first class all round, and can be highly recommended.

SCHUBERT — Song recital by Elisabeth Schwarkop (soprano) and Edwin Fischer (pianist) Columbia 33CX 1040.

In general, one can only approve and admire the singing of this disc for Elisabeth Schwarzkop has studied in the classic school of lieder and is well suited to it. I would have liked more contrast in mood. The songs demand it, and I felt her tendency was to sing them all without enough positive change in approach. The recording is extremely forward so that breath noises are rather apparent. Edwin Fischer, determined not to hog the limelight, at times does the reverse, but on the whole the combination is very good. A record all will admire.

BRAHMS — String Quintet No. 1 in F Major Opus 88. Played by the Vienna Konzerthaus Quartet with Ferdinand Stangler 2nd Viola. Westminster WL5027.

We are becoming used to high class playing from the Vienna Konzerthaus Quartet, or for that matter, any members of the Vienna groups. The playing in this disc is no disappointment although the addition of the second viola brings about a complete change in general effect from a string group to a small orchestra.

This is more noticeable with Brahms than it would have been with some other composers, for it is his tendency to keep the music moving all the time. The viola, too, is obviously included to give this extra body.

The quintet is a beautiful one, essentially happy in mood, with no shadow of introspection — nothing but sunlight and grateful shadows. It is played with a smoothness and sensitivity completely delightful.

The recording is appropriately more remote than some of Westminster earlier string records, but although some impact is lost, the general high quality and fine balance is there. Surface level is low.

MANFREDINI — Christmas Symphony in C Major. CORELLI Concerto Grosso No. 8 in G Minor. HANDEL — Concerto Grosso Op. 6 No. 12 in B Minor. Played by the Vienna Symphony Orchestra conducted by John Pritchard. Philips A00668R.

Three well known and beautiful examples of the concerto grosso happily grouped on one 10in record. Everyone will enjoy this music, filled with melody, grace and charm.

It is tastefully and most adequately played, although perhaps the orchestra sounds rather more massive than is truly authentic. I don't at all mind it that way, nor would I quarrel with the bit of extra reverberation which gives air to the performances and binds the sound together.

Balance is good, although the organ in the Manfredini could have been a little more forward. But it's hard to move organs just where they are wanted.

Technically it is a clean record without any noticeable flaws, reasonably good range, and quiet surface.

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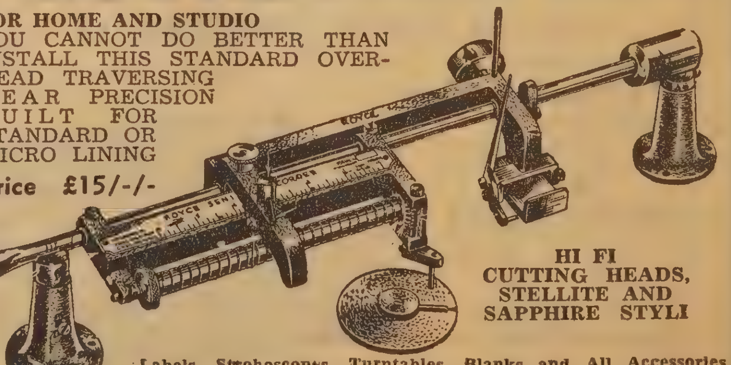

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NEW RECORDING CURVE COMING UP

As mentioned by Discobolus in this month's issue, it looks as though there may be a final standard recording or rather playback curve at last emerging from the confusion and misunderstandings of the past.

THIS is the Record Industry Association of America curve, abbreviated to RIAA.

When any industry such as the record industry makes a big move, there is always a period of settling down. It was inevitable that there should have been divergence of opinion in the matter of recording and playback curves, and only use and experience could determine which of many design considerations were the most important.

For instance, two main requirements of a playback curve are a degree of bass boost to compensate for the limitations imposed on recording amplitude at low frequencies, and a degree of treble cut to compliment the treble boost used by the recorder to help reduce surface level.

On paper this looks very nice, but when the amplifier designer examines ways and means of compensating his amplifier he runs into many problems which only now are really resolving themselves.

HOW MUCH BASS?

Most bass end problems revolve around how much bass you think you need. If you demand no compromise, letting your bass playback curve extend down to virtual infinity in a straight line, you strike two troubles right away.

Firstly, the compensator circuit must use an amplifier stage in which the overall gain is reduced during compensation at middle and high frequencies by an amount greater than the amount of bass needed, for boost is obtained only by allowing the amplifier stage to recover its full gain as the frequencies concerned become lower and lower.

This calls for high overall gain, sometimes using extra valves and naking it hard to get high input ensitivities economically.

Secondly, the worst trouble of all, lue to high compensation, is the ppearance of hum levels and motor rumble originating in the playback equipment. There is really no excuse for high hum level on the record itself, but where price is important, and mass production the rule, we do get motor rumble, and it is dangerous to allow the bass end to go too low without playback attenuation.

I have not seen the full RIAA curve, but it appears to be a duplicate of the RCA-Orthophonic in this respect, and for the same reasons. I think this is a very good move, and have been anticipating it—without much effort, I must admit—for some time now.

The amount of high note boost which should be used on recording is another thing which had to find its own level. Record surfaces have improved so much now that its use as a scratch reducer isn't nearly as important as it used to be. Consequently we can get away with less boost than seemed possible at first.

The main hazard with high degrees of top boost is distortion. Very high peaks, both electrical and physical, have to be handled right up to the stylus point, which really has a job to do in tracing heavily-recorded passages, particularly when the tip becomes worn. Of all the curves it would seem that the AES was nearest to optimum and apparently the top end of the new curve is virtually AES.

PLAYBACK CURVES

I think we should speak of playback curves as the logical approach. It is much easier to control the characteristics of a recording machine in a well-equipped studio, and managed by engineers, than it is for countless builders and operators of playback equipment to face a welter of switches and controls.

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(Continued on Page 109)

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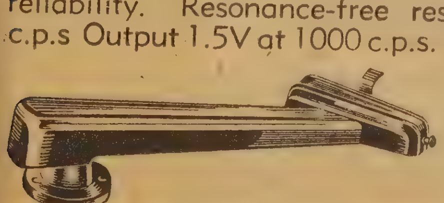

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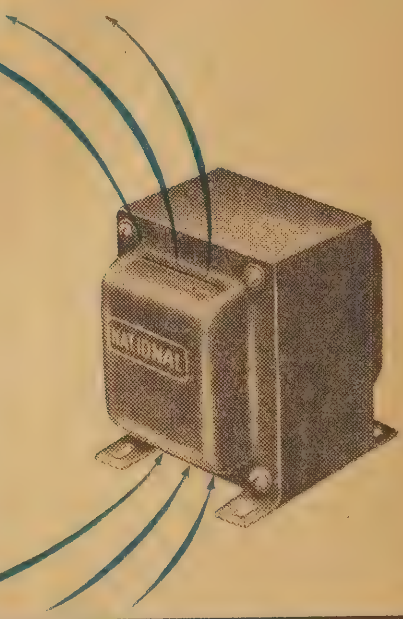

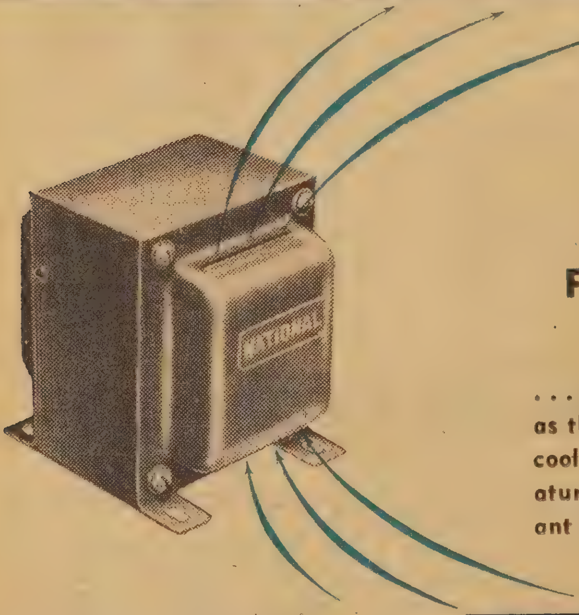

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RECORD NEWS FROM ABROAD

Since writing about the first LP release in England last month by Philips, in none too flattering terms, I have been able to read a number of reviews of the records.

By DISCOBOLUS

ALTHOUGH the remarks about their choice in discs still stands, it is gratifying to be able to pass on the information that the recordings are of a very high standard and have left a big impression on reviewers so far. The Berlioz Te Deum with Beecham has been described as "an auspicious debut in the field of choral recording" and others have been hailed with similar phrases. Their recording of four Strauss waltzes has been compared more than favorably with the sort of entertainment provided on Decca by Klemens Krauss in the "New Year Concert" series.

DECCA RECORDING

Unfortunately for Philips, their performance of the Strauss opera, Salome, has been overshadowed by the magnificent new Decca recording which appeared at about the same time. This is, of course, quite a common experience for Decca's competitors in the LP market. Like all companies, they have had their failures, but a glance at one of their more recent catalogues makes it obvious that they have a fair slice of the market to themselves.

Decca is the only English company to announce new releases for August, and their list is very small, consisting of two Beethoven Sonatas by Backhaus, chamber works by Beethoven, Haydn and Mozart played by the Italian Quartet; Wilhelm Kempff appears in the Mozart Piano Concertos Nos. 9 and 15 with a rather curious combination conducted by Karl Munchinger — the orchestra is from Stuttgart, but includes the wind section of the Suisse Romande.

Definitely in the high fidelity field are the new Decca "Planets", and he Julius Katchen recording of the Rachmaninov "Paganini Variations", lthough NIXA have given the market a bit of a shock with their new Planets disc, which is available n Australia already.

NEW CURVE

The new Curve of the Month s the RIAA (Record Industry As-ociation of America), and many of he new recordings from the American companies are already being made to its standards. EMI and thers have made no announcement oncerning its use, but I see that ecca are offering on the American arket a limited edition of 1400 opies of the set of Vaughan Wil-iams' Symphonies. And they are dvertising the fact that the RIAA urve has been used. The sym-honies have been available separ-ely in England for some months, nd it cannot be long before they e released in Australia. Decca e quite proud of the quality of ese discs: presumably the same rve is used wherever the records e being sold, so the RIAA curve ay be in use in Australia before ng. The difference between it d the RCA New Orthophonic is so little that a new switch position is not worth while considering.

Two new developments are at present taking place in America in Recording Tape. For the domestic user, one of the problems to date has been to secure adequate quality by playing at a high tape-speed and at the same time preserve a reasonably long playing-time.

Now, a solution in part is offered by the manufacturers of Audiotape in New York. From the Du Pont laboratories has come a new plastic base for tape, called Mylar, which is stronger by many times than the present base materials and has the additional advantage of being much thinner, so that it is now possible to store not 1200 but 1800 feet of tape on a seven-inch spool.

Colored tape is being used quite extensively in USA, the variety of colors making for easier identification of particular sections of the tape, especially for the professional recordist.

TAPES

"Pre-Recorded" tapes have never been very popular in America, as the music offered has been of little serious interest and prices asked have been too dear (about twice the price of a 12in LP of the same work, and—usually—of lower quality). Now it looks as though there will be a serious attempt in this direction, with a statement a few weeks ago from RCA Victor that they will make available a number of tapes of performances by Horowitz and Toscanini, in both single and dual track at 7½in/sec. Home-type recorders on sale over there are quite commonly quoted to have a response to 13 or 14 kc at this tape-speed, and this performance is now being achieved by Grundig in a new model just out in London.

PICKUP TRACKING

A novel approach to the problem of pick-up tracking is being offered by a new English firm. The "B.J." Pick-up Arm just available is for use with Decca and Acos heads, and is said to achieve a maximum error in tracking of one degree over the whole of a 12in disc. Construction is on very unfamiliar lines, and the simplest way to describe it is to say that the pick-up is automatically turned as it traverses the disc. The main advantage is said to be less distortion in the inner grooves of the disc. No doubt it also will be seen here soon.

If you are anxiously waiting the new 45's from EMI you will be interested to know that almost without exception they have already been deleted from the English catalogue, where they originated, in favor of Extended - Play 45's. "Pops" are still being sold in the "Short-Play" 45 version, but all of the light classical music has been withdrawn from sale in this form, and is now being reissued gradually in EP style.

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SHORT-WAVE NOTES BY ART CUSHEN

FLASHES FROM EVERYWHERE

TARAWAN, in the Gilbert Islands, remembered by many as the scene of one of the most fierce of the World War II battles, has now a short-wave service, and broadcasts in a local dialect, Gilbertese, are transmitted on 6050 Kc. The power of the station is not known, and the broadcasts are only one a week, Sunday, noon-12.30 pm but this will be extended later.

AMERICAN FORCES NETWORK, with transmitters now listed as Frankfurt now uses two frequencies, 5470 Kc with 250 W and 3188 Kc with 10,000 W and is on a daily schedule of 4.0 pm- 11.0 am.

UNITED NATIONS COMMAND, Tokio, which two years ago had special transmissions in Korean, during the UN operations in that country, have commended a new service, using 4780 Kc and have been noted with English at 5.30 pm, and later the program appears to be all in Korean.

INDIAN signals on 41 metres provide Australian listeners with some strong transmissions. At 9.30 pm, VUC2, Calcutta, using 7210 Kc opens transmission with a clock chiming five, then a program in a native language, is presented after station identification. English news is broadcast at 10.30 pm. Nearby 7240 Kc is the frequency used by VUB2, Bombay. which opens at 10.0 pm with a clock chime, followed by a broadcast in an Indian dialect. Delhi, opens at 10.0 pm on 7290 Kc making a third station on this band from India, all these signals have been noted by Rex Gillett in Adelaide.

GUATEMALA'S recent political upheaval has resulted in the National Radio of Guatemala, TGW-TGWA-TGWB now using a new slogan "Radio Nacional, Guatemala" instead of the old "La Voz de Guatemala" slogan. TGWB has moved to 6370 Kc and closes now at 3.15 pm, but at times remains on the air to 3.40 pm. TGWA continues to operate on 9760 Kc.

COLOMBIA'S HJKH, which causes widespread interest in the station when they commenced the session in English for Australia and New Zealand listeners, due to the many reports from this area, has at last verified. In recent broadcasts they have promised verification, and Harold Barrowclough, Dunedin, NZ, is first to report receipt of an air mail letter from A. Salcedo Rojas, who wrote in English.

The station uses a General Electric 25 Kw transmitter, located at Suatenza, 90 miles north-east of Bogota. Suatenza is located some 6000ft above sea level, and the aerial consists of a delta type. The broadcasts in English are still being received on 5075 Kc, on Saturday 8.30-8.45 pm, but at present the transmission appears to be only every second Saturday.

VRH4, SUVA, VERIFIES

Fiji Broadcasting Commission's new VRH4 operating on 3980 Kc verified reception with a letter from Mr. K. G. Collins, manager. A new verification card is in the hands of the printers and will be sent to all listeners reporting the reception of VRH4. VRH4 uses 500 watts, and the present schedule is Sundays 6.0 am-8.0 pm, weekdays 4.30-8.0 am, 10.0-noon, 2.0-8.30 pm (to 9.0 pm Saturday). VRH4 is located in the new Broadcasting House in Gladstone Rd., Suva.

The studios are located in this new building, which includes all new studio equipment, and the station was built at a cost of £30,000 which was loaned by the United Kingdom Government. The station manager, and most of his key members are all former members of the New Zealand Broadcasting Service, and the station operates a commercial program, with sections of non-commercial transmissions, the same set-up as the NZBS "X" class stations. Two broadcast band stations are planned, in addition to the present 2000 W station on 930 Kc.

RARATONGA HEARD ON 6180 Kc

The New Zealand Government has given permission for a short-wave station to operate at Raratonga, Cook Island, which is now using 6180 kilocycles.

RECENT agitation to the New Zealand Government by a group of radio technicians in Raratonga resulted in the Government granting them permission to operate a broadcasting station, using Post and Telegraph transmitters, reports Jim Shortall, Auckland.

The station is being operated at no cost to the Government, and commenced transmissions in April on 3390 Kc.

During early May the frequency was changed to 5050 Kc and the transmissions then consisted of broadcasts to schools in the Cook Islands, with broadcasts on Wednesday and Friday, 11 am-noon. Due to the good coverage an entertainment transmission was added on July 22 when the frequency was again changed, this time to 6180 Kc. This latter transmission takes place on Thursday 2.30-3.0 pm.

POWER 100W

A Post and Telegraph point-to-point transmitter is used, and the power is understood to be 100 watts, though a 500 W transmitter has at times been used.

Reception is good on 3390 Kc during darkness through the Lower Group, and the 5050 Kc outlet provides the best daylight coverage. Reports on reception from Niue in the west, to Manihiki in the Northern Cooks have been received.

Further extensions of the hour are expected to take place, and though reception in New Zealand at the moment is not possible, a later schedule on 6180 Kc would enable the station to be heard in this area. Mr. Douglas C. Cunnold is in charge of the station, and they would be pleased to hear from any listener who hears their broadcasts.

SHORT-WAVE SURVEY

A survey on short-wave listening, the extent of listening done by the average household, and the stations to which they tune to regularly, were some of the items covered in a recent survey of New Zealand conducted by the New Zealand Radio DX League and organised by Cleve Costello, producer of "This Radio Age."

THE finding of the survey will be the subject of a discussion broadcast in "This Radio Age" program over Radio New Zealand, on Tuesday, September 7, at 7.20 pm on 9540 and 9520 Kc.

The discussion group will be chaired by your short-wave correspondent, who with two other Invercargill short-wave listeners will discuss the interesting points which an analysis of the many hundreds of survey papers have made.

Though the survey was conducted in winter, the interest in short-wave reception must be at its lowest, due to reception conditions which rule out any reception over great distances after darkness. The survey in the summer, would have found more listeners interested in regular short-wave reception, when they can enjoy coverage of the globe and at entertainment strength.

The survey did point out the problems of interference from Australian stations, which is being experienced by the New Zealand broadcast band listeners. During winter every New Zealand station suffers from severe interference from Australian stations on the same frequency, with the exception of 2YA, Wellington.

Most popular among the short-wave stations is Radio Australia and the BBC, but due to the excellent signals throughout the year, from the former stations, they are easily New Zealand's most listened-to short-wave transmitters.

> ITEMS of interest concerning stations you are hearing should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times mentioned are Australian Eastern Standard.

RADIO PEKING is using a new frequency in the 75M band, and is being heard on 3960Kc at 9 pm. The new schedule for Peking lists the broadcasts in English. 1.00-1.30 pm, 11690, 15060, 15385Kc; 7.00-7.30 pm, 6100, 7500, 9040, 10260, 11690, 15060Kc; 12.30-1.00 am, 11690 15060Kc. The Home service from Peking consists of two programs, 1st program 8.00-9.40 am, 6100, 7500, 9040, 10260, 11835Kc 11.30 am-4.00 pm, 6100, 7500, 9040, 10260 11835, 15060, 15170Kc, 7.30 pm-1.05 am 3960, 6100, 7500, 9040, 10260, 11835, 15060 15170Kc; 1.10-5.00 am, 3960, 6100, 7500 9040, 10260, 11835Kc. 2nd program is carried on broadcast band, 728Kc. The 11835K frequency we have not heard, but Pekin was reported last month at 7.30 pm o 11935Kc, so it appears some error has bee made by the station's frequency list.

FAR EAST NETWORK: Tokio is nov using two frequencies during the tes broadcasts in the evening. Last mont we reported hearing the frequenc 11750Kc being used 7.00-8.30 pm, and the appear to change frequency and mov then to 6160Kc, and at 10.00 pm news i broadcast. Signals are good, and the usua identification, "This is the Far East Net work, Tokio", is given each 30 minutes.

Reports are verfied by R. H. Philip Radio Network Engineer, APO 613. c/ Post Master, San Francisco, Calif., USA.

PERU'S Radio Nacional, in Lima, whe closing at 2.50 pm, gives identification i English, Spanish and French. Reports o reception are requested, while at 2.00 p a broadcast in English is being hear The station only announces OAX4 6082Kc, but transmissions are also carri on OAX4T, 9565Kc, during the same pr gram.

JAPAN REGULAR

JAPAN'S first short-wave commerci station, news which we featured recentl when they were verified on test, are n being heard on the regular schedule. T best reception is on JOZ, 3925Kc, heard 9 pm. Verification from the station r ports that they hope to add an Engli section to the broadcasts, from midnig 1.00 am. The other 5000W relay, JO which was operating on 6095Kc, has be heard by August Balbi, in California, 6050Kcs at good strength.

SAUDI ARABIA'S broadcasts fr Jeddah and also the broadcasts fr Yemen are not broadcast on any fix schedules. The Jeddah station was hea by the writer when RCA engineers stalled the 7½kw transmitters some ye ago and tested on several frequencies. the transmitters observe local time, wh is a 12-hour period from sunrise to s set, which, if sunrise is 6 am, local ti at 7 am the time would be called 1 o'cl and thus a variation of a few min each day will be noticed. Bert Bluman Israel, who reports this item to World Radio Handbook Bulletin, st that only the broadcasts to Pakistan Indonesia are on fixed schedules.

THE HAM BANDS WITH BILL MOORE

Operation in the field on the VHF bands creates much interest, and contacts from elevated locations are often the forerunner of further communication between these amateurs from their home locations. Frequently they demonstrate what can be done.

THE NSW Division of the WIA VHF section will conduct on the six-hour day holiday weekend, October 2, 3, and 4, their annual spring 144 Mc field day. Previous field days have provided many interesting and distant contacts on this band.

The main purpose of this year's event will be to relay a message over the maximum distance possible. It is hoped that interstate VHF enthusiasts will co-operate to extend the distance covered.

It would appear from recent successful 144 Mc working that it should be possible to pass a message from Newcastle in the north through to south-west of NSW to Victoria and from there on to South Australia or Tasmania.

Stations will be operating portable from various elevated locations in country areas of NSW. Other Sydney and country stations will operate from their home addresses, allowing them to use maximum power and most aerial elements.

Main activity will be centred on the Sunday, although main stations will be heard on the Saturday and Monday, journeying to and from their selected locations.

It is hoped that the spring field day will be well supported and that UHF enthusiasts throughout Eastern Australia will operate on 144 Mc on the holiday weekend.

EMERGENCY NET

The announcement in the Press by the NSW Minister for Water Conservation, Mr. Enticknap, to the effect that a communications net was opened in the Hunter Valley was received with interest

The minister stated that Government departments, together with municipal authorities, had set up a complete radio flood-warning system along the Hunter Valley. The terminal of the net is at Maitland where the Flood Emergency Committee is run in conjunction with the local council.

In past emergencies radio amateurs along the valley had supplied the various net stations required to handle emergency traffic, and undoubtedly will stand by if required in future floods.

Amateurs in the valley since the war have built up a fine record of public service, but it is only to be anticipated that radio links maintained by Government authorities will be set up in vulnerable areas such as the Hunter.

Radio amateurs may be able to supply portable stations for areas likely to be isolated or similar service and still continue their valuable work.

VHF NEWS

The August meeting of the NSW VHF section was devoted to a lecture removed from amateur radio, the subject Jet Engines, and the lecturer, Mr. Ron Moppett, of De Havilands.

A new link on 144 Mc was opened up during late July when Jim Edge, VK2AJO, of Coolamon, contacted on a number of occasions C. Laughton, VK3ATN, of Birchup—the distance 250 miles. The longer path of 350 miles from Birchup to Hugo Stitt, VK2WH, of Forbes, has not yet been covered by a two-way contact, although signals have been heard both ways.

The next year should bring many good contacts on this band with so many stations from home QTH's in VK2, VK3 and VK4, working up to 200 miles, and stations heard up to 400 miles in the VK3/VK5 portable tests.

The NSW Division's new AOCP class for intending amateurs will commence in November and any inquiries on the course should be made direct to the class manager, Mr. Ken Kimberley, VK2AXZ, Box 1734, GPO, Sydney.

The south-western zone of the NSW Division will hold its annual convention at Tumut, the homes of VK2PN and VK2BQ. The dates selected are October 30 and 31.

Full details of the program will be published later, but any early information can be obtained from the zone officer, Jim Edge, VK2AJO, of Coolamon.

The results of the NSW VHF mid-winter contest were as follows:—

First, John Miller, VK2ANF, with a score of 39 points; second, Cliff Lamb, VK2LG, 37 points, and third, Adrian Rofe, VK2HE, 36 points.

ARRL BOARD MEETING

Decisions reached at the 1954 ARRL board meeting did not cover any subjects of great import to Australian amateurs. Quite often in the past, decisions of the board, especially those affecting occupancy of the high frequency bands, have had far-reaching effects on overseas amateurs. Any variation in the working of 120,000 amateurs must, of necessity, have some bearing on the activity of the world populations of radio amateurs.

Some of the more interesting points on which decisions were reached include the following:—

A request will be made to the FCC for a variation in the allocation in the 7 Mc band for novice class licences. An extension to 7150 Kcs is suggested. The band allocation would read from 7150 to 7200 Kcs. Such a variation would allow VK stations to make contact with novices more readily with the two bands meeting. Operation around 7150 Kcs should raise plenty of WN's on CW.

They will seek the removal of power restrictions in the 420 Mcs. and additional privileges in the 1800 to 2000 Kc band. They have directed that a short history of amateur radio be written, to be published in booklet form.

A decision was made to study the problems of the physically handicapped in amateur radio so that they can be fully assisted in their operations.

The general manager was directed to endeavor to secure the issuance of a commemorative stamp honoring amateur radio.

AI OPERATORS

One of the select groups in amateur radio are the members of the A1 operators' club.

The club is designed to recognise and promote good operating in the amateur bands and is conducted by the ARRL. To become a member one must be nominated for membership by at least two current members.

In choosing operators for the A1 operator club the following points are considered by members:—

General keying; well-formed characters and good spacing will be considered before speed. Similarly, good voice operating technique, clarity, brevity, careful choice of words, &c., are used in selecting telephony operators.

Procedure; use of the correct procedure is a natural qualification. Long CQ's, unnecessary testing, long calls, without signing, and all other poor practices are grounds for disqualification.

Copying ability; this is to be judged

NEW AMATEUR REGULATIONS IN U.S.A.

THE new US regulations covering the extension of the telephony allocations in the 14 and 28 Mc bands have been received with mixed feelings overseas.

These new telephony segments are as follows: 14 Mc band—14.200 to 14,350 Kcs; 28 Mc band—28,250 to 29,700 Kcs, and will change the allocation picture for telephony stations outside the US.

It is difficult to judge the full implications at this stage of these changes, as the W's are not audible for long at the moment.

Those who remember the number and strength of the US stations and the long periods for which they were continuously audible can perhaps appreciate the overall effect of these changes on operation from here in Australia.

The 14 Mc band is now completely occupied with W telephony stations to he high frequency limit; this will force stations outside the US on to the lower end of the band. The section 14,150 to 4,200 Kcs is now used by VE telephony tations, so exactly where other stations will fit is quite a problem.

PHONE PROBLEM

The section 14,000 to 14,100 Kcs for number of years has been used almost xclusively for CW operation. It is aparent that the phones can't fit in the 4,100—14,150 Kcs segment, so new arangements will have to be generally ccepted.

The 28 Mc allocation, too, forces telehony stations outside the US toward le lower end of the band, but the emaining frequencies available, 250 Kcs, aves more space for them.

CW activity on the band has been ther limited since the war and a few clusive Kcs for this medium would be fficient.

Overseas amateurs, including ourselves, n only hope there are no further creases in the US telephony allocations or they will find themselves competing directly with the kilowatt American stations; no easy task with limited power.

Some interesting points arise from the decision of the FCC in the US and her territories to conduct novice and technical class licences by mail only.

It really means that the amateurs themselves will have the responsibility of ensuring that these classes of licencees fulfil the examination requirement; in fact, amateurs will conduct these examinations plus other classes under certain circumstances.

The latter applies where applicants are more than 75 miles from the examination point. This licence examination condition has applied for a number of years in distant locations but it is now anticipated that amateurs as a body will conduct well over half of the total examinations given each year.

The licensing authority, the FCC, will have no contact other than by mail with applicants.

They will, of course, be responsible for the final grading of the technical papers as sent to them, but the amateur conducting the examination will be the judge as to the applicant's competency in the morse code.

The ARRL has pointed out in an editorial in QST that the standard of amateur examination procedure now rests with the amateur in the majority of cases.

BUDGET EASED

They should ensure that examinations should follow the requirements to the letter, and that the FCC's record of fairness and impartiality is upheld in these mail examinations.

The change will reduce the cost of examinations to the FCC and, together with the other economies to be effected, should help the authority to operate on a reduced budget.

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20	4/-	7/6	10/-
22	2/9	5/-	7/6
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METER SHUNTS

We make shunts to suit all meters. Those listed are to suit meters of 100 ohm internal resistance. 10, 25, 50, 100, 250 m/A. 14.8 and 166.6 ohms. Tolerance to .1 pc. Our price 6/9 each. Post free.

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SLOPING FRONT INSTRUMENT CASE.

Model 202.9 x 6¼ x 8in high. Front panel 9 x 7. Finished in black wrinkled enamel.
Our price .. 32/6.
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ITEMS NOT ILLUSTRATED

(but worth noting)

Rivets—	
Midget Hollow,	3/- pkt.
Aluminium	3/- pkt.
Self Tapers—	
Midget	3/- pkt.
Medium	3/- pkt.
Washers (brass)	2/- pkt.
Tinned Copper Wire	5/6 coil
Solder Lugs	2/- pkt.
Home Mike	10/-
2 Gang Cond.	12/6

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New places, or people you pass in the street, may seem oddly familiar to you. Have you known them in a previous life?

You wonder why you are living on earth to-day and for what purpose you are here. Certain secrets of life and mental development cannot be divulged indiscriminately. If you sincerely feel the need for instruction in the use of your higher creative endowment, you have reached the stage where the Rosicrucian teachings will be of practical value to you in your everyday life. Learn how to quietly impress your personality on others, to better your business and social position.

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by proficiency in copying through QRM and QRN, accuracy of copy as well as speed, &c.

Judgment and courtesy: the "CUL 73" operator can never make the grade. An operator should be courteous and will consider the other fellow's viewpoint.

The above four points, general keying (operating), procedure, copying ability and judgment and courtesy are applicable to all phases of amateur radio.

Each counts a possible 25 points (a total of 100) and each nominee should not be rated less 15 points on all four counts.

A suitable certificate is issued to each member by the ARRL.

The radio amateur versus local government authorities on the subject of antennas has again been listed for hearing in various US courts. For a number of years now the W's have been in litigation, ensuring their rights are not being infringed by local zoning regulations, and in some cases decisions of the Supreme Court in various States have been in favor of the amateur.

AERIAL RIGHTS

The amateurs supported in most cases by legal aid from the ARRL have won yet another case, this time in the Maryland Court, where the judge granted permission to W3LOE to erect a 60ft tower in the backyard of his house.

Again the opposition was afforded by the local zoning authorities (municipal to us).

Undoubtedly the original move was made by neighbors, who do not consider a tower and beam an improvement to the local skyline.

The verdict, as in other cases, stated that the backyard was the amateur's own "castle" and provided he did not offend public, health safety, morals, or welfare, he could do as he pleased in the way of erecting antennas.

Two new operating awards are available to amateurs. The "50P-50W" certificate is issued by the Mexican society, Liga Mexicana de Radio Experimentadores. In order to qualify an amateur must submit proof of contacts with 50 countries (one of which must be Mexico), using a maximum input of 50 watts. The minimum report acceptable is RST 438. Contacts may be on phone or CW. A certificate confirming the power must be submitted from the applicant's local radio club or society.

Applications, accompanied by the relevant QSL cards and seven international reply coupons, should be sent to M. A. Ortiz (XEISA), QSL Bureau, LMRE, A.C., Liverpool, 195 "A", Mexico 6, D.F.

The other award is issued by the ARAT, the Amateur Radio Association of Trieste, and known as the FTT certificate. It will be given to any licensed amateur submitting two-way contact with amateur stations in the Free Territory of Trieste.

QSL BUREAUS

Contacts may be on any of the amateur bands from 3.5 to 144 Mcs.

Full details can be obtained from the ARAT, PO Box 301, Br/US Zone, FTT, Trieste.

Amateurs are generally reminded that ot all National QSL Bureaus handle ards for non-members of their society. Most of the better-known societies will upply QSL cards to amateurs if they orward a stamped and addressed envepe.

Some other societies return cards for on-members. If a contact requests a ard directly only, he probably has a good eason for his request, and to ensure hat he receives yours, send it direct.

Reg Ross, VK3YD, recently received wo cards direct from 7 Mc contacts with LIAA, South Korea. Chang reports imself as legitimate and that amateur adio has been recognised officially since ne cease-fire.

The ARRL, however, still points out at HL (South Korea) contacts are not ermitted to US amateurs. Reg has been sting some good prefixes on 7 Mcs: inuded among them are ZC4, YV5, VR3, 2, &c.

Interesting comment arising from the ew licence conditions as granted in the K and mentioned last month is that number of amateurs suggest that the gulations should be more specific on erating methods. The RSGB points out licence full of legalistic terms and finitions could have been drawn up, t it was not desirable.

It would have meant that full observance of the licence terms would have had to be carried out at all times with no possible flexible arrangements as could now be made.

It was stressed emphatically that if amateurs require interpretation of any regulation, the request should be made to the RSGB, not the GPO. If the latter course is adopted the reply by necessity would be provided by the legal officer and possibly need further interpretation.

Throughout the years here in Australia, amateurs have been advised to act in a similar manner, requesting regulation interpretation through the WIA. The institute if necessary could then refer the matter to be PMG's department for clarification.

The following are QSL Bureau addresses that have been changed in recent months:—

Angola: LARA, PO Box 152, Luanda.
Costa Rica: Radio Club of Costa Rica, PO Box 535, San Jose.
Cyprus: Mrs. E. Barrett, PO Box 219, Limassol.
Germany: DL2 calls only, via Great Britain.
Quantanamo Bay: Leroy Davie, KG4AU, Navy 115, Box 13, FPO, New York, NY.
Mexico: LMRE, Liverpool, 195-A, Mexico, DF.
Morocco (Tangier International Zone only): PO Box 8150, Tangier.
Pakistan: Box 2002, Karachi.
Panama Republic of: LPRA, PO Box 1622, Panama.
Tripolitania: 5A2TZ, Box 372, Tripoli.

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Y77C

LET'S BUY AN ARGUMENT

(Continued from Page 89)

ance amplifiers to suit. For them as I have just suggested, speaker resonance is far enough down in the range and sufficiently well controlled as not to be a major problem.

If they build a vented enclosure, they normally—and wisely—pad it fairly freely and often cover the vent, for decorative purposes, with a layer of cloth. Such treatment has the immediate effect of limiting the resonant qualities of the enclosure.

And herein lies the answer why something, which looks so potentially critical on paper, actually behaves in such a non-critical fashion.

The usual, practical combination of an electrically "damped" speaker system and a heavily padded enclosure does not involve the fitting together of two opposing, highly-peaked response curves. Rather is it the combination of two very broad curves—and such a combination is never critical.

There may still be differences and discrepancies, but they will not be glaring ones. They may even be overshadowed, in some cases, by resonance modes in the listening room itself.

But just where is all this leading? Am I trying to say that the vented enclosure is an out-moded, even unwise method of baffling a modern speaker system.

No, I am not. I am merely suggesting that we revise our conception of the way it should behave.

By all means, ascertain the cone resonance of your speaker and build a vented enclosure for it. It will still probably be the best all-round compromise between size, simplicity and efficiency.

PORT SIZE

The relationship between enclosure volume and throat dimensions can be varied over a fairly wide range—just as you can vary the L/C ratio in a tuning circuit without changing the resonance. If you have to keep the enclosure small, you will logically have to provide for a throat rather than a simple vent.

Use an amplifier giving as low an output impedance as possible and, in line with this, use plenty of soft padding inside the enclosure. Try, if you like, a layer of cloth across the centre of the enclosure and across the throat. This will suitably broaden and damp the natural resonance, limit internal reflections and also help prevent the throat acting as a "pressure leak" for frequencies above resonance.

The net result of all this will be an enclosure which works well and is delightfully non-critical.

Of course, if space is no object, the enclosure can well be made deliberately oversized and it may well be the better for it, provided you keep it good and solid and well damped.

It appears that one can rely on the amplifier to control resonant "hang-over", as distinct from variation in output.

There doesn't seem to be any problem in that direction. What makes it hard are the attempts to produce enclosures a lot smaller than they should be.

They resonate too high in the range and attempts to kill the resonance with absorbent packing introduce a partial air-lock behind the cone, and that isn't good for bass response.

It was this very search for a smaller, workable enclosure that produced the RJ.

I still haven't built an RJ but I continue to hear widely conflicting reports on their behavior. Unless I miss my guess, they are proving to be rather critical.

When they work, they are tolerably good, considering their small size. When they miss out . . . well, they miss out.

Right now, I'm looking rather speculatively at a brick false-wall in front of the chimney and across the corner of my domestic lounge-room. If I rip out a few bricks and insert a timber frame, it should be possible to mount a speaker in the hole with complete separate between front and rear waves.

NO CUT-OFF

Since I have just indicated that the amplifier can look after the speaker's resonance, I don't have to worry about that. And, as far as the wall is concerned, it doesn't know the meaning of the term "cut-off". The only path between front and back of the cone would be out through the front door!

And why don't I build a horn? I can't and very few people can. You certainly don't call those things horns that people build up from partitions inside a box.

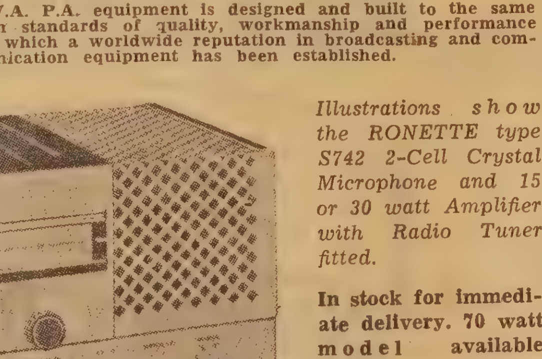
Have you ever stopped to think what these folded horns really do?

Over most of the range they function merely as direct radiators with an acoustic efficiency of say 5 pc The exact figure doesn't matter.

If they work at all as a horn in the bass register, the efficiency start to creep up and up, till it suddenl rolls off where the horn reache cut-off. If that isn't a form of bas boosting, then I'm a proverbia Dutchman.

Yet "Purist" types who hold u their hands in horror at the though of "unbalancing" the reproductio with electrical bass boost, never tur a hair when their speaker enclosur does precisely the same thing.

They even interpret the result a proof that their "horn" produce better bass than a "boom-box Human nature's a funny thing!



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Illustrations show the RONETTE type S742 2-Cell Crystal Microphone and 15 or 30 watt Amplifier with Radio Tuner fitted.

In stock for immediate delivery. 70 watt model available shortly.

Ronette "FONOFLUID" Turnover Crystal Pick-up. A new Hi-fidelity pick-up incorporating the famous TO-284 Cartridge in a chrome and ivory housing of new design to ensure minimum record wear and perfect tracking of both standard and micro-groove discs. AVAILABLE SHORTLY. Write for full particulars.

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Also at CAIRNS, TOWNSVILLE, MACKAY, ROCKHAMPTON, BUNDABERG, MARYBOROUGH, TOOWOOMBA, WARWICK.

Junior Multimeter

(Continued from Page 35)

of 1 pc. These are normally available to special order and are a little dearer than the normal 10 pc tolerance types. Note that the 500-volt range uses two .25 meg. to make the required .5 meg value. This is necessary to avoid changes in resistance value, which can occur if more than 250 volts is applied to resistors of this type.

The 13,500 ohm resistor should also be a 1 pc tolerance type, but the 1000 ohm resistor need only be a 10 pc type.

The 1000 ohm pot. is a standard wire wound type, which does not call for special comment. The switch is a single wafer, two pole, six position, and we suggest that this be one of the simpler types which are not only smaller physically but cheaper than some of the more elaborate constructions.

Four tip jack sockets are needed and these are a standard item. Although not essential when a bakelite panel is used the moulded bushings normally sold with them will improve the panel appearance considerably. We used one black (for the "common") and three red.

For connections to these at the rear of the panel you will require some solder lugs with a ¼in hole. These are not always readily available from radio suppliers, and we obtained ours from a motor car supply house. Ideally, they should be large enough to serve as a washer as well. If not, a ¼in washer, either metal or insulating, should also be used.

RESISTOR PANEL

A length of resistor panel with six lugs on each side is needed to accommodate the resistors and this will probably need to be cut from a larger section, which is the smallest standard size.

The actual construction is fairly straightforward, since there are only a few parts to be mounted. The panel measures 5¾in by 7 3-8in and s 1-8in thick. The hole for the neter was cut by drilling a series f holes just inside the required dianeter, breaking the small sections etween them and cleaning up with half round file.

The shunt former is mounted longside the meter and by one of he meter mounting screws. A seond screw holds the other leg and s a countersunk type hidden on the ront of the panel by the meter.

The multipliers and ohms resistrs are mounted on the terminal trip and this is then mounted on he meter by means of the meter erminals. These may be cut shorter desired, in order to reduce the epth of the box in which the intrument is to be housed.

To avoid changing the value of the pc multipliers it is advisable not heat them more than is absolutenecessary. For this reason the gtails should be left as long as ssible and a cloth soaked in methyted spirit used to cool the joint ickly.

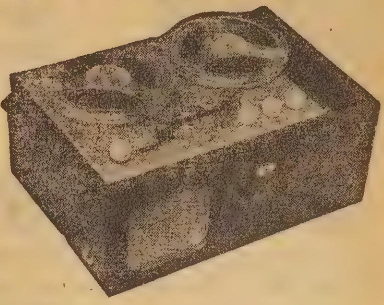
The batteries for the ohms ranges e three 4.5 torch batteries type 3 and one single cell, such as the pe 950. This cell need not be as rge as this, since there are no low ms ranges, but was selected be-

'NOVA'

THREE speed

KITSETS—HEADS—

DECKS—RECORDERS



(7½-3¾-1⅞in/sec) of highest fidelity and professional standard. Excellent musical reproduction at 3¾in/sec (up to 5500c/s) and at 1⅞/sec (up to 3500c/s) will give up to

4 HOURS ON 1200ft. TAPE.

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For Low Speed—Hi-Fidelity Recording and Playback on 3-Head Recorders. The Special .00025in Gap Head.

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Special **magnetic heads** in miniature with film guide **for 8, 9, and 16mm Film SINGLE SCREW MOUNTING, £7/9/-, including Shield.** REMEMBER:—'NOVA' is the **ONLY** firm making **commercial** tape-equipment, used in recorders and Tape-grams available to the self builder in Kitform.

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(as per R. & H., Feb., 1954)

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9/54

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I enclose LARGE self-addressed envelope and 6d in stamps.

NEW AMERICAN INDICATOR-UNIT

These Indicator Units contain the following Valves:—
Six 6SN7GT, one 6G6, one 6H6, one 6X5GT, one 2X2 and 3BP1 C.R.O. tube which is fitted in a separate shield on a 4ft shielded lead and supplied with control box and plug; case and shield are finished in black brocade.

£10/17/6 F.O.R. IN ORIGINAL CARTON

HIGH RESISTANCE HEAD PHONES (3000 Ohms)

THESE PHONES ARE USED BUT IN GOOD CONDITION SUPPLIED WITH HEADBAND AND CORD .. .. **22/6** per pair.

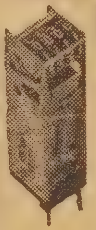
LOW TO HIGH IMPEDANCE HEADPHONE TRANSFORMER WITH PLUG — 5/- plus postage.

Brown's English High-Resistance Headphones 2000 OHMS. Supplied with headband and cord (new in carton). Per pair — — — — — — — — — — — — — — — — — 37/6

COMMAND RECEIVERS Q.5ERS

New command receivers freq. 190 to 550kc., complete with six valves.

£9/17/6 PLUS POSTAGE



NEW RELAY-TYPE-COUNTERS

These Electronic Counters counting from 0 to 9.999 have a 250 ohm coil

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Supplied in grey brocaded box complete with rectifier and transformer for 240V operation, £2/5/-

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MADE IN U.S.A.
24 Volts D.C., 1.25 amps.

Reversing connections. 11 segments commutator. Size as illustrated, with gearbox 3 x 3¾ 2 inches. Supplied complete with reduction action gearbox to approx. 100 R.P.M., also automatic electric brake for quick stopping. May be used without gearbox where required.

PRICE 37/6 each.
Packing & postage, 2/- extra.

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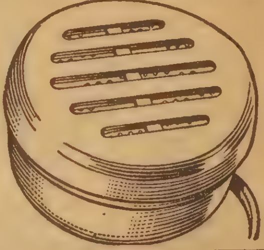
IT'S A REAL MINIATURE WITH ROLA UNIT

Install it anywhere, in the sick-room, workshop, garage or any room in the house. Just connect across voice coil of the existing speaker. The "PILLO-FONE" IS THE MOST CONVENIENT LITTLE UNIT YET DEVISED. 3½in Diameter by 1¾in deep. POST FREE **22/6**



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A.R.7 COMMUNICATIONS RECEIVER

These popular receivers covering from 140 Kc to 25 Mcs in five bands feature single strength meter, crystal gate, noise limiter, two RF and two IF stages. Supplied complete with nine valves, five sets coils, AC/Vib power supply, speaker and mounting rack. AIR TESTED. **£47/10/-**

AMERICAN WALKIE TALKIE CHASSIS

Less valves, case, crystal.

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PHONE LM3610

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3/511 and 3/521
3-SPEED CHANGER

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With lightweight, high fidelity twin crystal heads.

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Synchronous motor and drive in this unit is ideal for tape recorders.

NEW COLLARO SINGLE-SPEED RECORD PLAYERS

Type AC54 single-speed record-player with high-fidelity crystal head and automatic stop. For 240 Volts AC operation.

Special Price

£3/5/0

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New ovaltone dynamic speakers 9in x 6in 1000 ohm field and 5000 or 7000 ohm transformer -- -- -- **27/6**

SPECIAL PRICE FOR QUANTITY

Postage N.S.W. 3/6. Interstate 5/6.

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9001	10/-
9004	10/-
AV11	9/9
1K7G	9/6
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12 mfd-525V **4/6** each or **48/-** dozen plus post

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(Suitable for conversion to split-stator).

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Well known make of carbon resistors in values of 100 ohms to 5 megohms. In 1-watt, ½-watt and 1/3 watt. All resistors are standard colour coded and in original cartons. In lots of 100 mixed values comprising 50 1-watt, 25 ½-watt, 25 1/3-watt .. **12/6**

Post, 1/6.

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English multi-core solder in 1lb reels.

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The switch with a 1000 uses.

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The "Paillard" record changer has a variable speed motor making it ideal for dance halls, etc., and is fitted with a high fidelity crystal pick-up. Sapphire needle supplied with each unit.

BARGAIN PRICE **£7/18/6**

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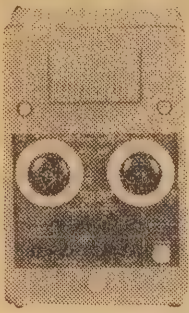
Nylex hook-up wire 10/.010 in 100 yard coils, each coil consisting of five 20 yard lengths in 5 different colours.

10/- PER 100 YDS. Plus postage.

A.R.8—COMMUNICATIONS—RECEIVERS

Converted for 240v. AC operation



Including power-supply, 9" x 7" ovaltone speaker

A.P.8 receivers are manufactured by A.W.A. and have a continuous coverage from 140 K.C. to 20 M'CS in six switched bands. Set contains 13 valves as follows: 3-6A8G, 4-6U7G, 2-6V6G, 1-6B8G, 1-X5G, 1-6V4, and 1-6J7. Receiver, speaker and power supply are fitted in attractive and durable plastic-covered instrument case which makes this unit complete and portable. On/off switch and tone control are also fitted.

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Supplied with valves (11) power supply lead and plug. Air tested £23/17/6 F.O.R.

Supplied less valves and covers with power supply lead and plug. £9/17/6 F.O.R.

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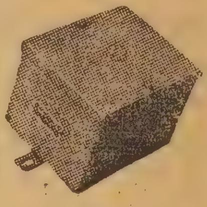
A.C. POWER-SUPPLY FOR AR8



240 volt A.C. power supply for use with any A.R.8 receiver. Supplied in brocaded finished case, with standard A.R.8 power supply plug fitted. Ready to plug into your receiver. Output 250v at 125MA. with 12 and 6v filament windings.

£7/17/6
F.O.R.

Circuit supplied free with all A.R.8 receivers

A.T.5 TRANSMITTERS

A.T.5 Transmitters supplied complete with valves (3-807 and 2-6V6), plug and circuit.
Price £9/7/6

A.T.5 Transmitter less valves.
With circuit £5/5/-

A.T.5 Transmitter less valves and covers.
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HIGH-POWER I.R.C. RHEOSTATS

250 ohm, 25 watt.
10 ohm, 2½ amp; 25 ohm, 1 amp
Price, each 10/6

CRYSTAL PICK-UP CARTRIDGES

Rothermel high fidelity pick-up cartridges, replacement for most pick-ups.

10/6 each.

BUTTERFLY CONDENSERS

Capacitance range 3-35 micro-farad. Size 1¼ x 2¾ x 2¼ inches, brass plates: Ultra high frequency insulation: ¼ inch shaft.
Price, each 7/6

Packing and postage: NSW, 1/-; Q., T. and V., 1/6; W.A., N.T., 2/-.

New A.W.A. VIBRATORS

6 or 12 volt A.W.A. gas filled vibrators, heavy duty, synchronous.
Price 15/-

(Special price for quantity.)

D.C. GENERATORS

12V 750 watt. Ideal Home lighting. Battery charging, etc.

PRICE £4/10/- F.O.R.

TRICKLE-CHARGER KITS

Kits for trickle-charger as described in R. & H., June issue. Comprising transformer with 18V winding tapped at 12V-3 100mA rectifiers and 50 ohms control.
Postage: NSW, 5/-;
Interstate, 7/6.

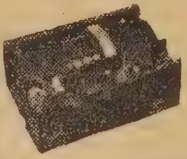
39/6

COSSOR C.R.O. TUBES

Ideal for oscilloscopes or TV sets. New 6in tubes.

VCR97	47/6
VCR138	42/6

SCR 522 GENEMOTORS



28 volt input D.C., regulated and filtered output filtered D.C. 300 volts at .26 amps; 150 volts at .01 amps; 14.5 volts at 5.0. Completely shielded in metal case, 12 x 8 x 5 inches.
Price, F.O.R. Each 55/-

A.T.5-A.R.8 POWER SUPPLY

24 volt genemotors supply containing two genemotors, one giving 550 volt at 350 mills and the other 250 volt at 100 mills, also contains filter condensers, relays, fuse holders, etc.

£4/10/- F.O.R.

TYPE 1133 TRANSCEIVER

Freq. range 90 to 130 m/cs contains 17 6.3 volt valves.

£8/17/6

METROPOLITAN RADIO SUPPLIES

479 Parramatta Road,
Leichhardt, N.S.W.
(at top of Taverner's Hill)
PHONE LM3610

TRANSFORMER SPECIAL

H.D. Power Transformer, 265 x 265 250mA 4v Fil. Windings	£2/5/-
H.D. Power Transformer, 365 x 365 150mA 4v Fil. Windings	£2/5/-
C.R.O. Transformer, 1540, 2V Filament Winding	£2/5/-
150mA Filter Choke	£1/2/6

Prices F.O.R.

Postage extra.

NEW MN26 COMPASS CONTROL-BOX

37/6

23 pin plug for MN26 compass. 37/6.
18 pin plug for MN26 control box, 25/-.
6in Flexible drive for above, 10/-. 24in, 18/6.

SPECIALS

Bakelite Fuse Boxes	4/6
5-Position Push Button Switches,	12/6
Carbon Mike Trans	4/6
Double Button Carbon Mikes ..	7/6
Throat Mikes	5/-
Cutler Hammer Switches	2/6
Shielded Hook-up Wire, yard ..	8d
3 gang Standard Condenser ..	20/-
Twin Co-ax Cable, 20ft lengths ..	6/-
2 gang Condenser	16/-

NEW WESTON & FERRANTI METERS

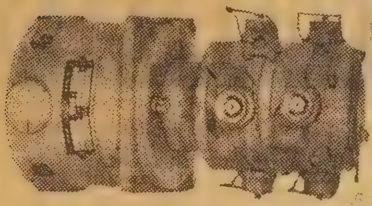
0-.5 amp. RF thermocouple	9/6
0-3 amp. RF thermocouple	9/6
0-4 amp. RF thermocouple	9/6
0-10mA DC	17/6
0-20 volt DC	17/6
0-5 amp. DC	27/6
0-10 amp. DC	27/6

(All above are 2in flush mount.)

0-10mA DC English Turner 3in Round Flush Mounting 30/-

Postage Extra.

SMALL 24-VOLT AC/DC MOTORS



29/6
PLUS POSTAGE

AMERICAN ANTENNA SWITCHING MOTORS

Complete with 8 Pye-Type Co-ax Bases, R.P.M. 1750, Ball Bearing.

AMERICAN REDMOND BLOWER MOTORS

Ball-bearing, fully laminated, 6000 R.P.M., 1 amp spindle 1¼ x ¼. Complete with blower, new in carton.

45/- PLUS POSTAGE

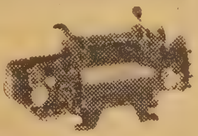
39/6
PLUS POSTAGE

Small 24v ball-bearing motor. Reversible, fully laminated, approx 1/15H.P.

Size 3¾" x 2½" with ¼" diameter shaft.

New Transformers Suitable For All Above Motors to Operate off 240v A.C. 30/- ea. plus postage.

Heavy Duty Genemotor



Suitable for conversion to A.C. motor (approx. one sixth H.P.) Fully laminated. Can be used as 6 or 12 volt generator at 20 or 13 amps £2/17/6 f.o.r.

NEW-AMERICAN TELEPHONE WIRE

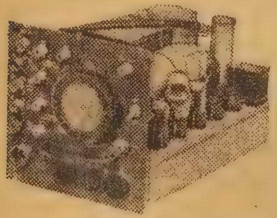
Rubber insulation with stainless steel and copper conductors supplied on metal reels each containing half-mile of wire. £1/15/- per reel. Case lots, each containing six reels (three miles of wire). .. ..

£10 PER CASE F.O.R.

£1/-/-
Postage N.S.W. 4/6
Interstate 8/6

PORTABLE TEST SET

Containing 2½ inch 0-50 millimeter, six point key switch, &c., in case.
(Used equipment.)



AMERICAN INDICATOR UNIT

These indicators are ideal for conversion to cathode ray oscilloscope having a built-in power supply, the power transformer only needs changing, and there is plenty of room for a time base tube etc. Supplied complete with the following valves:—
3BP with full length mu-metal shield, two 6SN7GT, two 6H6, one 2X2, one 6X5 and one 6G6G .. .. Freight extra **£8/17/6**

TRANSFORMER TO CONVERT THIS UNIT FOR 240 VOLT OPERATION AVAILABLE AT £3/15/- EXTRA plus postage

MIDGET GENEMOTOR

Input 28 to 32 volt at 1.1 amp output. 250v at 60MA

New in carton	£2/15/-
Used but in good order	£1/18/6

Postage extra.

Input filter supplied with genemotors

28 VOLT GENEMOTOR

Input 28 to 32 volt at 1.5 amp. Output 250V at 100MA. Used but AS NEW -- -- -- -- £1/18/6

POSTAGE EXTRA

6-VOLT GENEMOTOR

Input 6 volt Output 500 volt at 160 MA.

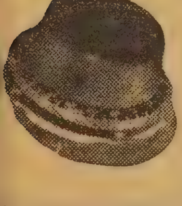
£6/10/- F.O.R.

HIGH-VOLTAGE GENEMOTOR

Input 12 volt. Output 1200 volt at 200MA.

£6/10/- F.O.R.

VERNIER DIAL



American velvet vernier dial 100 to 1 calibration. Supplied with ceramic coupling 20/-

METROPOLITAN RADIO SUPPLIES

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(At top of Taverner's Hill)
PHONE LM3610

OIL FILLED CONDENSERS

2mfd. 1800V -- -- --	17/6
4mfd. 200V -- -- --	4/6
8mfd. 500V -- -- --	10/-
1mfd. 600V -- -- --	5/-
.5mfd. 2500V -- -- --	6/6
.25mfd. 3000V -- --	6/6

Postage extra.

ANSWERS TO CORRESPONDENTS

A.H. (Burwood, Vic.) requests that we supply constructional data of instruments for testing motor-car performance. He mentions condenser testers, volt-amp testers, tachometer and cam angle meter and exhaust gas analysers among others.

A. We do not have any constructional data ready at the moment but the matter has been at the back of our minds for some time and we hope that the opportunity to produce something concrete will arise before too long. In the meantime we would welcome letters from readers who are interested in the subject or who have any suggestions to make.

W.J.C. (Toowoomba, Q.) writes to express his appreciation of the magazine and to ask a few beginner's questions.

A. Back numbers of Radio and Hobbies are usually available for a few months after publication and a few odd issues for longer periods. In general, however, few issues are regularly available after about three months. If there is a particular issue you require we will advise if it is available. Alternatively we can supply copies of most circuits as indicated in the panel on this page. A neon tester is a very sensitive device and the capacitive coupling to the user, and, in turn, to earth, is sufficient to provide an indicating current, thus revealing which lead is above earth potential. We cannot suggest any particular use for throat microphones other than to use them experimentally in simple telephone system. We have no valve data of the type you mention but we suggest you contact the various valve manufacturers and bookstalls who have a variety of publications on the subject. Apart from the local publications available from the manufacturers we particularly recommend the RCA Receiving Tube Manual.

S. de B. (Queenstown, Tas.) inquires whether there is any reason to suppose that the number of sets in a district which are tuned to a particular station would have any effect on the signal strength of that station. He also advances an interesting theory regarding the effect of tuning on a receiver by a powerful station.

A. There seems to be little to support the theory regarding the effect of a number of receivers tuned to the same station. The case of the UHF aerials is not quite parallel since in this case the aerial is tuned to the frequency concerned. In the case of a broadcast receiver the aerial is not in any sense tuned and, at the most, is loosely coupled to the first tuned stage. In practically every case this coupling is far too light to cause the aerial to act as if tuned. It is likely that the presence of aerials would distort the field pattern to some extent, but this would be constant rather than subject to the tuning of the set, as you suggest. Your theory regarding frequency modulation tuning is a rather radical one and we find it difficult to agree completely with your suggestions. However, we may be able to discuss the matter at greater length in the Argument page at a later date.

K.J. (Alphington, Vic.) submits a number of queries which he requests be answered in these columns.

A. We will deal briefly with the questions here, K.J., but we may treat some of them in greater details in the "Answer Tom" section. In any generator the use of permanent magnets is only satisfactory in very small machines, such as bicycle lighting sets, telephone generators, &c. For greater sensitivity use the headphone with the highest impedance. However, don't expect anything outstanding in the way of quality, and be prepared to purchase a proper microphone for serious work. The earth normally acts as a very effective shield against radio waves and only very strong signals would normally penetrate any distance under the ground. There is nothing to be gained by going underground for radio reception since any shielding against unwanted noise would apply equally to the wanted signal. Ships normally use the water as the earth for their radio circuits, though a large ship would provide enough mass to act as an effective earth without need for connection to the water. There would be little point in going to a lot of trouble to use the ocean as an earth unless it was the closest object. Results would not be significantly better. As far as we know there is no method of detecting metal without the use of valves of some kind. A lot of these devices have been available through disposals stocks. All metals act as a very effective shield against radio waves and a room completely screened with wire mesh will have virtually no pickup if all leads into it are adequately filtered. We have no data on the construction of hydro-electric plants but we have a pamphlet available on the construction of a wind generator. This is available through the post, price 1/-.

C.J.T. (Melbourne, Vic.) has a crystal set and an old horn type loudspeaker and wants to know if it is possible to use the latter to amplify the signals from the crystal set.

A. Sorry, C.J.T., but there is no magic formula whereby a crystal set may be made to operate a loudspeaker except in very favorable localities. It is important to realise that a loudspeaker is of itself, quite incapable of supplying any amplifying action and is really a very inefficient device. It differs from a headphone mainly in its ability to handle a lot of power when this is available. as from a normal set. The job o raising the signals to a suitable level is performed by the set, not the loudspeaker. It would be possible to add a valve to the crystal set which would amplify the signals, but the availability of a valve and the power supply to g with it opens up the possibilities o much more efficient receivers and ther is no longer any point in retaining th crystal detector. Some circuits alon these lines are available through our mai query service if you care to avail yourself of it.

J.B.E. (Notts, England) sends a advertisement for insertion in the classified section.

A. Your advertisement has been referred to the appropriate departmen and should appear in due course. Th receipt and any refund will normall be posted direct to you by the advertising department.

A.G.W. (Canberra, ACT) wishes t substitute valve types 6AL5 or EB91 fo the 6H6-GT specified for the oscillosco described in the June issue of last yea

A. Either of the valves you mentic would be quite satisfactory in place the 6H6 without change in the circu We do not know of a miniature equiva ent of the 884. The only possible mini ture substitute we can think of is th 2D21 which is a seven-pin gas tetrod However, there may be some difficul in getting it to operate satisfactorily a sweep oscillator.

W.H.D. (Brisbane, Q) wants to kno whether there is a battery valve in th current miniature range which is simil to the type 49.

A. As far as we know there is miniature version of this valve.

M.G.W. (Horsham, Vic.) wants to g some idea of disc recording principl and advances a brief outline of the pr cess as he sees it.

A. In general your ideas are corre M.G.W., though some of the details ne modifying. The cutting head is driv from an amplifier and microphone a the cutting needle vibrates at auc frequencies. It is possible to use sor magnetic pickups as cutting heads, thou few of the modern lightweights wou stand up to work of this kind. ordinary amplifier can be used but is really necessary to make provision frequency compensation for any seric work. A series of articles on disc recor ing appeared in Radio and Hobbies co mencing in the November, 1950, issue

B.L. (Northbridge, NSW) submits circuit of a two valve AC receiver a an arrangement for adapting it for as a single valve battery operated se

A. Many thanks for your interest letter, B.L. We are filing your circ with a possible view to including it i future issue of Radio and Hobbies in Reader Built It section of the ma zine.

THE "RADIO & HOBBIES" QUERY SERVICE

ALL queries concerning "R & H," designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to others readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three "R & H" constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis will now be 4/6. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, "RADIO and HOBBIES," Box 2728C, GPO, Sydney.

Note that "RADIO & HOBBIES" does not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

THE R. & H. JUNIOR MULTIMETER

(Continued from Page 103)

ause it is a readily available type. lmost any other size would suit.

The wiring was done with tinned opper wire protected with insulatng sleeving and this makes a neat ob and is easy to handle. The only ook-up wire used is to connect to he batteries.

VIRING UP

The actual connections to be made n wiring up the instrument are hown in the circuit diagram and we re also printing a wiring diagram or beginners. Whichever you use, ou should not find the task a paricularly difficult one, since there re only a few connections comared with a radio set.

When the wiring is completed you hould make a thorough check of before attempting to use the meter. emember that a wiring error could ause the meter to be seriously overaded and damaged.

If everything appears correct the oltage ranges may be checked with 1.5 volt battery, preferably in conunction with a 1000 ohm resistor to rotect the meter in the event of irect connection to it. If all apears well, the battery may be connected directly and then higher voltages used.

For the current ranges a similar source of power should be used and adjusted to pass not more than 1 mA. This will give sufficient deflection on all ranges to indicate that all is well and the higher ranges may then be checked on more suitable values.

OHMS TEST

The ohms ranges are easily tested by using resistors of known values, remembering that they will probably have a tolerance no better than 10 pc. However, this order of accuracy is usually sufficient for radio work.

Finally, the switch positions should be marked on the panel by some means in order to avoid setting the switch to the wrong position and overloading the meter. You may do the work yourself using a lettering pen and white ink or paint, or you may have the job done by a professional engraver. In the latter case the "works" will have to be slipped off the panel, but this can be done without damage if a little care is exercised.

SOME SPACE TRAVEL PROBLEMS

(Continued from page 13)

pplies could be carried without difulty, but the problem of air supy for the pressurised cabin has icited several ingenious suggesns.

Best of all, is the use of plants ich absorb carbon dioxide and erate oxygen, to ensure a balced atmosphere. Excess humidity, oduced by perspiration by the ew. could be removed by circuing the air through a pipe outde the rocket body, to freeze t the water vapor.

Pressurised suits would enable the ew to move outside the cabin when necessary and leave the rocket when it had reached its destination.

This is all very well, and shows the undying adventurousness of man, but it is all far from reality and belongs to the distant, if not infinite, future.

Nevertheless, the universal interest and activity which is being shown is to be encouraged, for, there is the remote possibility, that some as yet unknown scientific discovery may make what is now seemingly impossible, a practical proposition.

RADIO & HOBBIES STANDARD TUNER

(Continued from Page 61)

d we will assume that the IF nsformers were lined to 455 Kc fore they left the factory.

Tune in a station toward the low quency end of the dial and ghly adjust the slugs in the aerial RF coils for best volume. If station does not appear at its rect spot on the dial, adjust the g in the oscillator coil until it ves to its correct spot. Readjust aerial and RF slugs for best ume.

Now tune in a station toward the h frequency end and roughly ust the aerial and RF trimmers best volume. If necesasry, ad- the oscillator trimmer until the ion is tuned at its correct spot the dial and readjust the aerial RF trimmers for best volume. back to the low end and recheck slugs—then once more to the end and recheck the trimmers.

Select a weak station and adjust the slugs in the top and bottom of each IF transformer for best volume, going over the adjustment twice. If a "peak" is found for two positions of a slug, select that "peak" which is farthest out.

Remember that when lining up the tuning, the slugs are used for adjustment at the low end, and the trimmers for adjustment at the high end.

During the alignment procedure, it is advisable to use a just-sufficient length of aerial to give a workable level of signal strength from the stations used so that the AVC action of the set does not mask the accuracy of adjustments.

When completed, guard the adjustments against vibration by dropping nail polish, coil "dope" or wax on to the slugs and the head of the trimmer screws.

NEW RECORDING CURVE COMING UP

(Continued from Page 95)

compensation position on their equipment, even if it was one of many, they could record to any characteristic they pleased with a view to making it sound best on this curve. In fact, this goes on by design or accident right now.

For builders of control units, it might be a good thing to abandon the AES altogether if a choice has to be made. Many AES recorded discs will sound just a little less bassy with the new curve, but anything than a perfect record might be improved with a reduced amount of hum and motor rumble. Incidentally, the difference in the bass is a roll-off at about 50 cycles, and not a general reduction as given with the extra bass control normally fitted. It isn't the same thing therefore to use AES with one degree of bass cut.

In the last control unit of the Playmasters, it is probable that the new curve can be obtained by the addition of one resistor.

RADIO ACCESSORIES

We specialise in Radio Parts and stock all reliable brands. We can supply: Coils, I.F.'s, Transformers, Resistors, Tubular Condensers, Valves, Wires, Flex, Meters, Testing Equipment, Radio Manuals, Irons, Toasters, Pressure Cookers, Jiff Toasting Irons, Trimmers, Padders, Gang Condensers, Motor and Pickups, Record Changers, Cabinets, Solder Irons, Solder and Electrical Accessories, 4 and 5 Valve Mantel Sets — Portable Sets, Console Radio and Radiogram, etc, Mantel, Console and Radiogram Cabinets. TECNICO Electric Lawn Mowers, Floor Polishers and Vacuum Cleaners. 2 and 3 Speed Motors and Turntables.

G.P.20 Pickups and Microgroove Heads.

DAVIS RADIO CO.
Wholesale Radio Distributors,
1st Floor, Wembley House,
841 George St., Sydney
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Phone M3917
OPEN SATURDAY MORNINGS

SONGSTER
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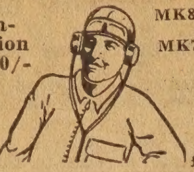
NEEDLES

R.A.F. LEATHER FLYING HELMETS 35/- each



Intercommunication Tubes 50/-

PHONES 12/6

Polaroid Goggles 48/6

MK8 Goggles, 48/6 PR.
MK7 Goggles, 37/6.

WOOL LINED FLYING BOOTS £5/15/- pr.

Genuine RAAF outer Waterproof Suits £7/15/. All sizes.

Stock and Die Sets, ½in, ¾in, and 1in water pipe, **£4/19/6**

IN FIRST CLASS ORDER DALTON COMPUTERS IDEAL FOR AERO CLUB 45/-.

230 volt AC, NEON TESTERS, 4/6.

SURPLUS

512 Elizabeth St., Melbourne, C.I.
'Phone: FJ5904. Just 4 doors
Mail Orders Carefully Packed
Please add Freight or Postage

At last! The spotlight you have been waiting for

63/6

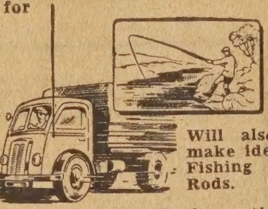
Complete with flex and switch.

Fitted with genuine American sealed bean 6-volt globes. No motorist or boat owner should be without one.

Ideal for Fox or Rabbit Shooting.

STEEL ARMY TANK AERIAL RODS, WILL MAKE IDEAL RADIO AERIALS FOR CARS OR TRUCKS.

Too long for postage. Advise nearest railway station.

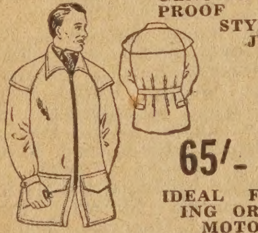


Will also make ideal Fishing Rods.

Base to suit Aerial, 9/6 each.

12ft long, 3 sections. Each section 4ft, 22/6. 8ft long, 2 sections, 15/-.

GENUINE WATERPROOF AMERICAN STYLE SAFARI JACKETS.



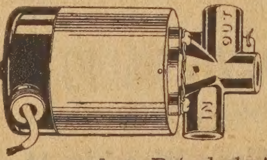
FULL FRONT ZIPP FASTENER

65/-

IDEAL FOR MILKING OR ON THE MOTOR BIKE

LIQUID SHUT OFF VALVES

Will work off 12 or 24 Volt, ideal for Water or Alcohol Injectors.

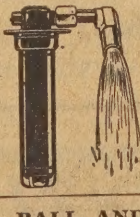


50/-

Can be used as Petral shut off for car protection. Many factory uses.

24-VOLT MOTOR COMPLETE With Fuel Pump

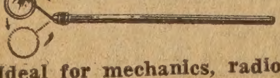
Ideal for Caravans. Takes the place of Hand Pumps.



Many uses on the Farm. Will transfer Petrol or any Liquid from Drums, etc. Will work from 24 or 32 volts AC or DC.

£5 each.

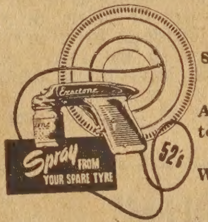
BALL AND SOCKET INSPECTION MIRRORS



8/9 each

Ideal for mechanics, radio repairs.

SPRAY YOUR CAR, TOYS, HOBBIES, FURNITURE

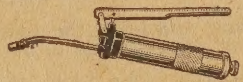

Spray FROM YOUR SPARE TYRE
52/6

52/6

Spray from your Spare Tyre.

An Ideal Tool for touching up damaged paintwork. Will spray Lacquer, Paint, Enamel.

BRAND NEW LEVER TYPE GREASE GUNS WORTH £4/19/6

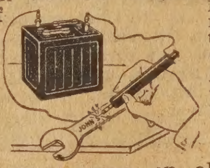


59/6

Ideal for all types of Trucks, Tractors or Cars. 7500lb pressure.

ELECTRIC ENGRAVER

What everybody has been waiting for. An Electric Engraver that works off your car battery.



Ideal for name tags, dog collars, plant labels, etc.

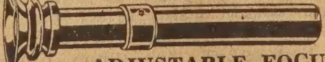
Engraves anything in metal.

29/6

Engrave your name on all your tools. Marked tools are never stolen. No Garage should be without one.

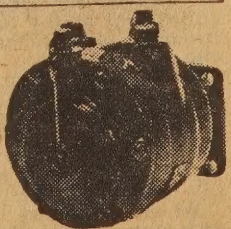
ARMY FOCUSING TELESCOPE

Easily converted for use on dumpy levels.
Can be used as a rifle sight.
Excellent magnification .. £4/19/6
Fitted with cross hair.



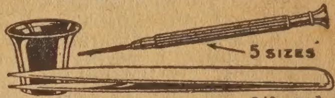
ADJUSTABLE FOCUS

AMERICAN VACUUM or AIR PUMP



Builds up air pressure to 20lb at 1000 R.P.M. develops up to 120lb of hydraulic pressure; will pump 7½ gallons S.A.E. oil or other liquids per minute. Useful for spraying, milking, presses, oil burners, hydraulic systems. £3/10/-.

WATCHMAKERS AND INSTRUMENT MAKERS



English Tweezers	6/6 and 5/
Eyeglasses	6/6 and 8/
Extra strong Double Lens Eyeglasses	15/
Screwdrivers, set of five	13/

Replace those broken side curtain with cellulose acetate which take the place of celluloid and lasts fou times longer. Will not discolor.

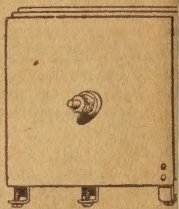
32/6 SHEET

Non-inflammable acetate sheet i recommended for all types of sid curtains. Sheets are 20 thousandth of 1 inch thick. Size of sheet, 24i x 52in. Can be sewn or cemente into frames.

Not Secondhand.

BRAND NEW ENGLISH G.E.C. RECTIFIERS

Make yourself a Battery Charger.



12v.	2 amp,	32/6
6v.	6 amp,	49/6
12v.	3 amp,	45/-
6v.	2 amp,	24/6
6v.	4 amp,	45/-
12v.	5 amp,	79/6

Transformers to suit above Rectifie 2 amp, 37/6; 6 volt, 5 amp, 45/-; 12 vo 5 amp, 55/-.

COMPLETE BATTERY CHARGE

Fitted with Brand New English Selenium Rectifier.

Works off 230v Househ Supply

Charges any battery, 6 volts at 4 am £6/15/- complete. Also available, 6 12 volt Chargers combined. Charge amps, £7/15/-. Brand new 6 volt, amp Chargers, complete, £5/2/6.

ENGLISH ARMY SPOTLIGHT

IDEAL FOR SHOOTING. FIT ONE TO YOUR CAR.

Fitted with Mirror Reflector.
6-volt 37/6 12-volt 2

English Motor and Blower, 24 volts.

39/6

Will work off any Lighting Plant.

Large size also available that work off 12 or 24 volts £3/15/

STORES

512 Elizabeth St., Melbourne, C.I.
from Victoria Street. Phone FJ5904.
and Efficiently Despatched.
Include State in Address.

SPECIAL DISPOSALS METER OFFER

MILLIAMPERES

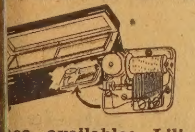
0-10 amp meters, AC-DC 2¼in dial,	45/-
0-10 milliamp, 2½in dial	37/6
Weston 0-50 volt 0-100 amps combined M/coil,	£3/10/-
English 50-0-50 Ammeters, M/Coil	37/6
Eng. 0-50 Ammeters, AC-DC ..	42/-
English 0-20 Voltmeters, M/Coil ..	25/-
English 0-40 Voltmeters, M/Coil ..	25/-
English 0-300 AC-DC Voltmeters ..	55/-
English 0-5 Milliammeters, 2¼in. ..	27/6
English 0-25 Ammeters, 2½in M/c. ..	30/-
English 0-10 Ammeters, 2¼in dial, Moving Coil	45/-
English 0-30 Voltmeters, 2½in dial, AC-DC	42/-
English 0-40 Ammeters, 2¼in dial, AC-DC	42/-
Eng. 0-5 Ammeters, AC-DC	45/-
Eng. 0-3 Ammeters, 2¼ dial, AC-DC	45/-
English 0-150 Voltmeter, 3in dial, Moving Coil	39/6
Eng. 0-500 Micro Ammeter, M/Coil	37/6
Eng. 0-150 Ammeter, 3¼in dial, AC-DC	75/-
Eng. 0-20 amps, 2in dial, M/c.	25/-
ng. 0-1½ Milliamps, 2in dial, M/c.	19/6
ng. 0-20 Milliamps, 2¾ dial, AC-DC	17/6
ng. 20-0-20 Ampmeter, M/coil ..	37/6
ng. 0.30 Amps AC-DC 2¾in dial	42/-
ng. 0-50 Amps AC-DC 3¾in dial	75/-
ng. 0-60 Amps AC-DC 3¾in dial	75/-
ng. 0-80 Amps AC-DC 3¾in dial	75/-

RMY SPOTTING TELESCOPES

Iany uses on the farm. Ideal for Sheep Spotting.

seful on the rifle range, 3 draw in long, 6½in closed, 1in object ns, 18 magnification. ade in England **£7/19/6**

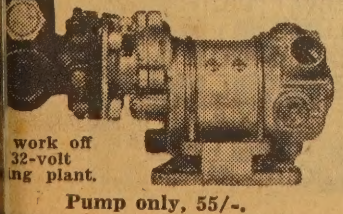
w you can make your own music x with these Swiss music units. ey can be fitted to any type of box, l, jug, teddy bears, etc. Hours of oyment for all the family.



30/- EACH

es available: Lili Marlene, Jingle s, Blue Danube, Harry Lime me, Wedding March, The Merry ow, Happy Birthday, Annie Laurie, Dry We Are, Roll Out The Barrel.

craft 24 volt Motor complete h 400 gal. per hour Pump. Made in America. Ideal for pumping any liquid. Many uses on any farm, £14/14/-.



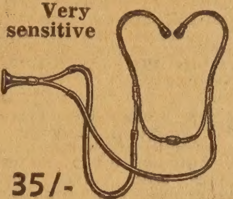
work off 32-volt ng plant.

Pump only, 55/-.

MECHANICS' STETHOSCOPES

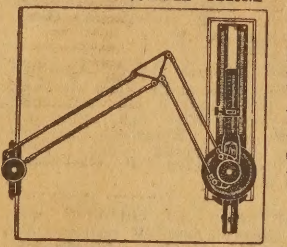
Ideal for Testing Engines, etc.

Very sensitive



35/-

R.A.F. PLOTTING BOARD WITH ARM



Bakelite Base. Draws Angles Parrallel or Vertical.

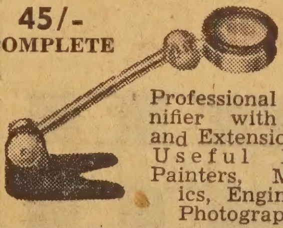
70/-

IDEAL FOR ENGINEERS, STUDENTS, ETC.

HYDRAULIC SPECIAL JUST LANDED

Hydraulic Gear Pumps, 1200lb pressure, 5 gals. per minute.
USED £5/15/-.
BRAND NEW £7/10/-.

45/- COMPLETE

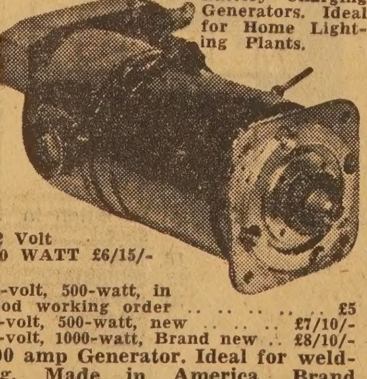


Professional Magnifier with Stand and Extension Arm. Useful Doctors, Painters, Mechanics, Engineers, Photographers.

Brand new AEROPLANE WHEELS

IDEAL FOR WHEELBARROWS HAND TRUCKS, TRAILERS, etc.

10½in x 4½in £4/15/-, complete with tube



Battery Charging Generators. Ideal for Home Lighting Plants.

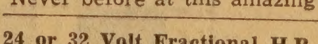
12 Volt
750 WATT £6/15/-

12-volt, 500-watt, in good working order	£5
12-volt, 500-watt, new	£7/10/-
24-volt, 1000-watt, Brand new ..	£8/10/-
200 amp Generator. Ideal for welding. Made in America. Brand new	£50
Tested and in perfect order ..	£35

SPECIAL OFFER

American Schrader tyre pumps, work from your spark plugs, **39/6.** Fish pond aerators, work from 230 volts, **57/6.** Commando Telescopes, ground lens, **45/.** Sampson low pressure Spray Guns, **£6/17/6.** Aircraft Pressure Gauges, 0 to 20lb pressure, **22/6.** 0-200lb, **25/-.** Pressure type Oil Cans, **15/6.** Aircraft Rev Counters, extra long lead, ideal for boats or cars, **75/-.** All Steel Mechanics' Tool Boxes, lift out tray, **32/6.** Magnifying Glasses, 8 mags, **8/6;** 10 magnifications, **12/6.** Metal Drill sets, 1-16 to 3-16, 9 Drills for **3/6.** 24 volt motor and hydraulic pump, capacity 3½gals. per minute, **£3/15/-.** New headphones suitable for crystal sets, **17/6** pair. Genuine Stanley Lino Cutting or Hobby Knife with 5 blades, **9/9.** Brand new Army Mosquito nets, ideal camping, **35/-.** Genuinne RAAF Berets, **10/6.** Surveyors Abney levels. New Price **£18/18/-, £7/10/-.** Army paint, oil base, blue or grey, **25/-** gal. German Army marching compasses, work similar to prismatic, full instructions with each, **29/6.** Brand new American Cutting and welding torches, **£5/15/-** complete. Army Slouch Hats in good order, **15/-.** ¼in Black and Deker 230 volt Electric Drills, **£12/16/-.** ½in, **£26/11/-.** Bench Head Grinders, complete with ½in Emery Wheel, **35/6.** Hydraulic pumps, 1200 p.s.i., 8 1-3 gal. per min.; **£18/18/-;** 5 gal. per min., **£7/10/-.** Generator Test Meters, 35-0-35 amp meters, 4¼in dial, **45/-.** 0-10 volt meters, 4¼in dial, **45/-.** Loading Resistors can be supplied to make meter read 10.20 at **12/6.** Medical Scalpels, many uses, photographers, etc., **6/6.** Shaded Pole induction Motors made by Hoover of England, 230 volts, AC. Ideal for Projectors, Tape Recorders, Fans, etc., **£4/19/6.** SAE open end Spanners, 6 to set, **24/6.** Whitworth, 4 to set, **18/6.** 2½in Paint Brushes, set in rubber, special price, **10/6.** Brand new 7-8in Spark Plugs, suit most old type cars, **2/6 ea.** Tapped Transformers, 6, 12, 18 and 24 volts, 3 amps, 39/6, 230 volts input Army Steel Tow Ropes with looped ends, 17/6. Army Tripod for photographic work, levels, etc., 41in long, **22/6.** SAE or Whitworth Spanner sets. Open one end, ring the other, 6 spanners to set, **25/-.**

ARMY FLUTES

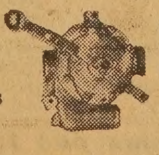


39/6

Ideal for School Bands.
Never before at this amazing price.

24 or 32 Volt Fractional H.P. Electric Motors. Makes ideal miniature Grinders, Mixers, etc., 50/-.

Brand new American Wobble Pump, semi-rotary



PHOSPHOR BRONZE VANES

Continuous flow, £3/19/6.

Ideal for caravans, emptying or filling petrol tanks, watertanks, etc.

WANTED TO BUY, SELL OR EXCHANGE

FOR SALE: Hallicrafter communications receiver. Model S40. 9 valve, 540 Kc/s to 44 Mc/s. 110V, or 240 volt A.C. Accessories, headphones, 12in speaker. Instruction manuals. Outstanding performance and condition. £60 or better. **6 Gaynor Court, Malvern, Vic.**

FOR SALE: Movie Camera, 9.5mm, silent, good condition. Type Motor Camera "B" with two films, length 30ft.; also one 300ft reel of the Coronation, one 200ft reel of Mickey Mouse Cartoon. £20 the lot or offer. **Tony Loricco, 50 Murray St., Colac, Vic.**

FOR SALE: Class B 100 watts 830 driver and modulation transformer. Sell or exchange, converter or 10-watt modulator. What have you? **2 Darling St., South Yarra, Melbourne.**

FOR SALE: (1) Nova 53 R/P tape head. (1) 53/E head. £3/10/- each. (1) Two-speed brass flywheel with bearings, £2/10/-. **Mitton, Pinnacle Rd., Grenfell.**

FOR SALE: Partly-built 100-watt rack and panel transmitter, including 811's and 866's, prop feathering-motor, 3in CRO, AMK3 Tx, Tx condensers, other sundry ham gear, bargain prices. **T. A. Thorpe, 5 Shadforth St., Mosman, N.S.W. XM7691.**

FOR SALE: Expert Moving Coil Pick-up, Diamond microgroove stylus, complete with transformer, new, £19. **Walton, 347 Kent St., Sydney. BX2051, JJ3185.**

FOR SALE: R. & H. 15-ohm speaker voice coil, filter unit, £3 only. Call weekendes, or write, **Advertiser, 17 Fairmount St., Dulwich Hill.**

SELL: R. & H., Dec., '51, to now. **WM4096, Sydney.**

FOR SALE: Two lattice steel towers at present erected at Lochinvar, N.S.W. 115ft high. Easily lowered, dismantled and transported. Can be purchased singly if necessary. Highest offer accepted. Further particulars, etc., from **Hunter Broadcasters Pty. Limited, 24 Hunter Street, Newcastle.**

FOR SALE: FS6 Transceiver, in good condition, original case, resprayed grey with black trimmings, Hiesing plate modulated, V.F.O. or crystal, and complete wtih cables, mike, headphones. What offers? **R. Alm, Box 229, Clare, S.A.**

SALE: Large quantity radio gear, old and new. Most Radio & Hobbies, 1947, to date. Suit beginner, experimenter. £40 lot or offer. **A. R. McWilliams, Greylands, Turrawan, N.S.W.**

FOR SALE: 35-watt S.T.C. Amplifier with 2 8in wide angle flare speakers for outside P.A., and 3 8in hall spkr. finished in cream. With mike stand and Tannoy Hi-Fi mike. Excellent P.A. job. Good order. 12 months' work. Value cannot be beaten, £150. **P. Gatehouse, Milton, N.S.W.**

WHAT OFFERS: 109 complete with power supply, new 6V battery, 6V6 output with 3in speaker, fones, mic, leads, etc., not proofed, very clean condition, carrying cases cream enamel. Not junk. Eddystone 750 receiver, complete, with "S" meter, 12in Rola P/M on 1in baffle board, excellent performer, new condition, suit budding ham. Reply **Box 139, Cootamundra.**

SELL: Admiralty P26 Rx, 144 Mc/s, £4½; new 829-B, £4½; Army No. 22 PSU, £2; No. 19 PSU, £2; new No. 101 TxRx less Tubes, £8. **1 Darley Rd., Randwick.**

SELL: Playmaster No. 1 Tuner. Built by Electronic Parts Ltd. New, never been used. (Cost £28.) Take £15. (D/W Model.) **Rye Radio Service, Rye.**

SELL: Printing. Special Offer:—100 Business or Visit Cards 30/-; 100 Letterheads, 30/-; 200, £2. Sent anywhere by mail. Do it now! **W. Hiley, 841 George St., Sydney.**

SELL: Converter, Val Radio, DC/AC. Type 230/150/12A, input 12V DC, output 230V AC. As new. £15. **JB2058.**

SELL: Decca XMS 78 PU as new; £4. Precision Gimbal PU Arms, adaptable to every head, write for further details. **S. Wearne, 15 Moore St., Elwood, S.3, Vic.**

SELL: As in June issue (except Inverter and 1-5 hp Mot), plus 8in vent. Enclosure, £6. **H. Smith, 38 Marley St., Sale, Vic.**

SELL: New R. & H., June, '54, Playmaster Seven Amplifier, complete with No. 4 control unit. 10 watts response, 2(to 30,000 cycles. Well constructed. Freigh free. £49. **P. Gatehouse, Milton, N.S.W**

SELL: Professionally-built Playmaster No 6, 8-watt amplifier, with 2-ohm voic coil. Provision for tuner, £24. Also Rol 120X speaker, in vented enclosure. A specified by manufacturer. Price £25 Call weekends or write **17 Fairmount St Dulwich Hill.**

SELL: D'motor, 12V in 300, 150 and 13 out. Relay, V.R., 50/-. Com'd Xmtr £5/17/6. AT5's, £9/10/-. A.C.U. 45/-. AR Rec. £17/17/6. R3121 13-valve with 18-vo d'motor, £5/17/6. MN26 £17/10/-. 1(valve indicators £10/10/-. Automati Morse, contains 2 240V AC intrs. £13/10/ TR1143A, 2-valve, £11/7/6. TR9F, 9-valv 67/6. 1155 rec. £19/17/6. Earphones 2/3 e **R. Hallyburton Stonyford, Vic.**

SELL: BC348 Receiver, £40, complete Elem. Beam, £50. **UL2133, Sydney.**

SELL: GE Pickup Head, Diamond stylu £14. Arm if needed, £1. Fine importe walnut vented Cabinet, £17. Transforme Williamson type, £2/10/-. New 2A3 6A3's, 15/- each. Goodman treble speake £2. **JA8647, 10 Lamette St., Chatswoo Sydney.**

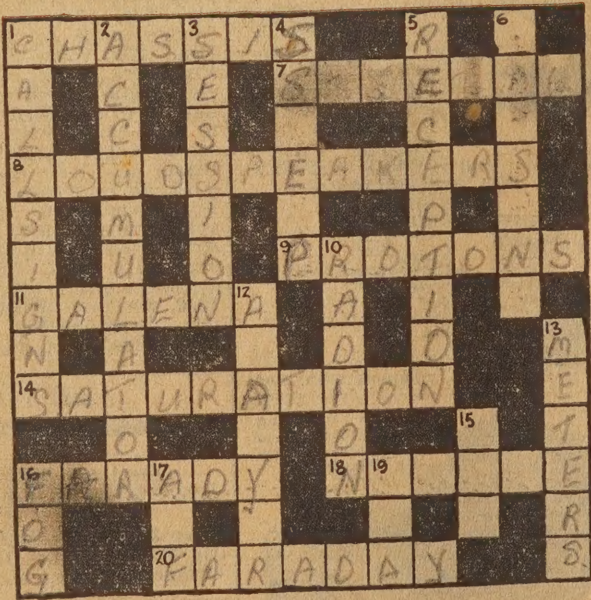
SELL: 301A Receivers £5/10/- eac A.R.B. Receivers £19/10/-. Mete Valves, Transmitters, etc., at barga prices. **Suburban Radios, 334 Charles S North Perth.**

SELL: Radio and Electronic Equipme new and used; gears, electric moto valves, meters, etc., available at **Ele Radio Sales and Service, 350 Wellingt St., Perth. Phone BA 2395.**

BUY: 16mm sound or silent film—mu be cheap. **D. Adams, 80 Victoria S East Maitland.**

WANTED: Several ART-13 Transmitte in good condition, less Power Su plies. **Box 1677, G.P.O., Sydney.**

THE R. & H. CROSSWORD No. 7



ACROSS

1. Basic metal structure.
7. Used in earliest receivers.
8. Audio reproducers.
9. Basic electrical particle.
11. Type of detector.
14. Condition of maximum current.
16. Dr. Lee De......?
18. Birthplace of international television.
20. Type of electrostatic screen.

DOWN

1. Station identification.
2. Secondary battery.
3. Radio program segment.
4. Raises plate resistance.
5. Converse of transmission.
6. Strain.
10. Type of insulating cloth.
12. Allows interchange of certain valves.
13. Current indicators.
15. Variation in speed.
16. Mist.
17. Potential.
19. Home of color television.

Solution and further crossword next month.

Last month's solution